DOCUMENT RESUME

ED 036 274 HE 001 372

AUTHOR BEARD, RUTH M.
TITLE RESEARCH INTO TEACHING METHODS IN HIGHER EDUCATION. 2ND EDITION. RESEARCH INTO HIGHER EDUCATION MONOGRAPHS.
INSTITUTION SOCIETY FOR RESEARCH INTO HIGHER EDUCATION, LTD., LONDON (ENGLAND).
PUB DATE SEP 68
NOTE 70P.

EDRS PRICE EDRS PRICE MF-$0.50 HC-$3.60
DESCRIPTORS *COLLEGE TEACHERS, *EFFECTIVE TEACHING, *HIGHER EDUCATION, LEARNING PROCESSES, PROGRAMED INSTRUCTION, *RESEARCH, SURVEYS, *TEACHING METHODS
IDENTIFIERS *BRITAIN

ABSTRACT

THIS MONOGRAPH SURVEYS MOSTLY BRITISH RESEARCH ON TEACHING IN HIGHER EDUCATION. MOST OF THE WORKS CITED APPEARED IN THE '60S. NO BRITISH STUDIES HAVE BEEN MADE TO ASSESS THE EFFECTS OF WHOLE COURSES. ASSESSMENT IS USUALLY BASED ON STAFF-STUDENT CONFERENCES OR QUESTIONNAIRES. SOME STUDIES HAVE BEEN DONE ON THE OBJECTIVES OF COLLEGE TEACHING. ECONOMISTS ARE BEGINNING TO INVESTIGATE THE EFFICIENCY AND PRODUCTIVITY OF UNIVERSITY EDUCATION AND EXPERIMENTS HAVE BEEN MADE WITH PROGRAMMED LEARNING. SUBSTANTIAL RESEARCH HAS BEEN DONE ON THE RECALL AND RETENTION OF INFORMATION, AND SEVERAL EXPERIMENTS HAVE BEEN MADE BASED ON THE FINDINGS OF PSYCHOLOGISTS. THE USE OF THE LECTURE SYSTEM, AUDIO-VISUAL AIDS, AND STUDENTS' ATTITUDES TOWARD VARIOUS TEACHING METHODS HAVE BEEN EVALUATED. STUDIES HAVE BEEN MADE OF THE VARIETY OF SKILLS AND ABILITIES REQUIRED IN LEARNING AT THE UNIVERSITY LEVEL, AND OF TEACHING METHODS THAT CHANGE STUDENTS' ATTITUDES AND INCREASE THEIR MOTIVATION. RESEARCH HAS ALSO BEEN DONE ON THE CORRELATION BETWEEN STUDENT SELECTION AND ACHIEVEMENT AND ON WAYS OF EVALUATING TEACHING AND LEARNING. COURSES AND SERVICES FOR UNIVERSITY TEACHERS ARE DISCUSSED. (AF)

research
into
higher
education
MONOGRAPHS

RESEARCH INTO TEACHING METHODS IN HIGHER EDUCATION 2nd edition

Ruth M. Beard

The SOCIETY FOR RESEARCH INTO HIGHER EDUCATION is a registered charity and was set up in December 1964 to encourage and co-ordinate research into all aspects of higher education. It seeks to make research findings more widely available and to promote their more effective use.

The Society

organises conferences, study groups, seminars and other meetings at national and regional level;

holds an Annual Conference at which recent research findings are presented and discussed;

maintains a Register of research in progress;

issues a quarterly series of Abstracts of the more important literature;

reports on matters of interest and publicises its activities in a monthly Bulletin;

publishes reports and review monographs;

collects unpublished research material, thus enabling it to be made more widely available;

works in collaboration with other national bodies interested in research into higher education and seeks to establish contact with overseas organisations.

Membership of the Society is open to institutions (corporate subscription: 15 guineas per annum) and to individuals (subscription: 3 guineas per annum).

Enquiries are welcome and should be addressed to The Secretary, Society for Research into Higher Education Ltd., 2 Woburn Square, London, WC1.

Dr. Ruth Beard is the holder of two degrees in Mathematics and two in Education. She has taught in grammar schools, a comprehensive school, a college of education and two University Institutes of Education. Dr. Beard is currently Senior Lecturer in Higher Education and is in charge of the University Teaching Methods Research Unit, University of London Institute of Education. The Leverhulme Trust financed the Unit between 1965 and 1968 and has promised support to an investigation into objectives in teaching which will begin late in 1968.

FOREWORD

When this monograph first appeared at the end of September 1967, we planned to bring it up to date in 1969; but the first issue sold out in eight months and a fairly large volume of additional material has already accumulated so it seems probable that there will be a sufficient demand to justify this second enlarged edition in September 1968.

Within another year the volume of relevant publications on teaching methods in higher education is likely to be so great that anything less than a complete reorganisation of content of the monograph will be impracticable. Meanwhile, we hope that this year's insertions have been made with sufficient skill to avoid obvious breaks in continuity. For the convenience of readers who already have the 1967 edition and wonder whether it is worthwhile to buy the second, new references have been listed separately at the end.

Only one new section has been added; this is on the subject of courses of training and services for university teachers and inquiries into their value. Since training of teachers in higher education is now under consideration, the various patterns it has so far taken and the views of teachers on its length and content, or on services they find helpful, are likely to be of general interest. The section on mechanical and manual skills has been considerably extended, although largely by drawing on findings in industrial studies, and substantial additions have also been made to the sections on objectives, economy and efficiency, selection and evaluation. Growing points, such as the uses of simulation techniques and role playing in the social sciences, where material has only recently begun to accumulate in Britain, and extensive analysis of objectives which are just beginning, will be discussed at greater length with other new developments in the next revision of the monograph.

RMB

ACKNOWLEDGEMENTS

The author wishes to thank Miss E. Bull and Dr. R. Oxtoby for reading the first draft of this article and making useful comments and Dr. Brian Lewis for raising and discussing a number of interesting topics, some of which are now mentioned in the monograph.

CONTENTS

INTRODUCTION

During a recent course for new lecturers in the sciences at the University of London Institute of Education a number of small group discussions were held on methods of teaching and on aspects of learning and relevant findings in research. The majority of the participants enjoyed the discussions and found them profitable; but one group leader, a psychologist, reported as follows of discussion in a group drawn from various departments: "It was striking to find that university graduates, with sometimes years of research experience, were unable to apply to the problems of teaching the same methods of scientific inquiry they would, presumably, use in their own discipline: statement of problem, collection of observations, statement of hypothesis, test of hypothesis by experimentation including appropriate controls". The same group leader reported of a further session of discussion "...the discussion seemed to go very little way towards encouraging a scientific approach to teaching: statement of aims, experiments in teaching method, evaluation of teaching and of student learning. Even the paucity of factual data on these was not appreciated."

Perhaps scientists whose subjects have a sound theoretical foundation do not feel at home with a subject which lacks a theory. For, not only is there no theory of teaching to turn to when problems arise, but theories of learning are too numerous and too little concerned with human learning to provide a framework for action. Teachers cannot design courses taking into account the numerous variables in learning and personal interactions, but must introduce innovations largely on the basis of induction from their observations. Nevertheless, we should expect that scientists, if not other university teachers would appreciate the need to experiment to determine the effectiveness of innovations introduced in teaching.

Reports from other groups suggested that this one may have been somewhat exceptional, but their non-scientific attitude to teaching was repeated in an appreciable minority of participants in the course. On the whole such an attitude was less prevalent among biologists, doctors, dentists, psychologists and specialists in education, all of whom are accustomed to experimenting with variable, living organisms, than among mathematicians, physicists, chemists and engineers who handle or observe more predictable inanimate materials and symbols. What differences there are probably arise from basic differences in experience, some of the physical scientists considering experiments non-scientific if the conclusions can be stated only in terms of probabilities. Since, in addition, by no means all educational experiments are rigorously designed, some scientists may tend to reject the results wholly. But, in doing so, they discard the few sound beginnings in scientific method which have so far been made in the educational field and revert to attitudes and subjective judgements appropriate to a pre-scientific era. The remedies lie in more widespread use of good designs in educational experiments as well as appreciation on the part of teachers that results of experiments which are stated only in terms of probabilities may yet have value in guiding policies or in the selection of teaching methods.

Until comparatively recently all changes in university teaching were due to outstanding innovators in the universities or followed on recommendations of committees and professional bodies. Few of these have been directly influenced by findings in the psychology of learning or experiments into the effectiveness of teaching methods but were based almost exclusively on teachers' views as to how the subject should develop, their experience of learning and teaching and knowledge of methods used elsewhere. The findings of psychologists are unlikely to supersede such recommendations by experts but should contribute to them increasingly. Since in the case of preparing programmed books, or setting up television as an aid to teaching, for example, expenditure of time or money may be considerable, there has been a fairly large number of experiments to determine their value as compared with traditional teaching. It is also the psychologists, and lecturers who have taken part in teaching experiments, who have made us aware that some innovations in teaching prove to be stimulating for a time, like fashions, but may soon produce no more response than their predecessors. Consequently any conscientious attempt to devise ways of teaching which are essentially more effective must involve the teacher in specifying his aims, devising methods to achieve them and undertaking, or allowing, an evaluation of their success in terms of students' achievements and attitudes over a period of time.

The experimental work mentioned in the ensuing pages is restricted to that in British higher education, mainly in universities, to the end of 1966. Two surveys already exist of American work [22, 66] but these will be referred to only where the contributions of research workers in America greatly exceed those from British sources.

AIMS AND OBJECTIVES

In teaching any subject, clarification of aims is essential for two main reasons: firstly, in the majority of subjects there are many possible objectives so that, if time and resources are not to be wasted, a choice must be made between them; secondly, it is only possible to determine whether teaching and learning have been effective if it is first decided what they should achieve. Aims need to be defined at a number of different levels. The ultimate goals of a course, such as acquisition of professional competence and appropriate attitudes, must be decided by specialists in the field from their combined knowledge of subject matter and social demands on the profession; but, once these are settled, many intermediate goals are needed both as a guide in teaching and to provide students with direction in studying and a sense of achievement as each goal is attained.

It is perhaps hardly surprising that very few attempts have been made to assess the effects of whole courses, for it is a considerable and lengthy undertaking. There are no British studies of the kind, but inevitably there is some

feed-back into the universities as to the adequacy of students' training when they take up their professions. It is sometimes suggested, for example, that industry needs scientists with a more general scientific training to enable them to adjust to inevitable changes in technology with greater flexibility, and many General Practitioners are critical of medical training as a preparation for their profession. To some extent this may reflect the different attitudes of theoretical and applied scientists. The theoretician tends to remain in the university and may be poorly informed about practical applications of his subject, whereas the practical scientist tends to disregard theory except in so far as it is immediately useful. Both attitudes raise problems for students. Engineering students, for example, complain when taught by mathematicians who cannot show how to apply their mathematical knowledge whereas, if taught without a sound theoretical basis by men from industry, their knowledge cannot be readily adapted to changing conditions. The theoretician will most probably be satisfied with evidence that the student has sufficient understanding to explain or reorganise what he has learned and to make inferences, generalisations and predictions from it; but all this demonstrates is that he has a capacity to organise his knowledge mentally; it provides no evidence of ability to apply knowledge. The practical scientist needs to be taught principles and applications together and this objective can probably only be attained by closer co-operation between teachers from different fields.

New courses to meet demands for greater flexibility have recently been introduced in Queen Elizabeth College, University of London[115] and in the department of physics at the University of Surrey[121]. The former allows students to select from nine to twelve approved 'course units', where a 'course unit' represents 'one third of the total work load which every student who is capable of obtaining a degree at all should be able to manage' in a year. A two-subject degree may, therefore, be taken with a number of different weightings between the subjects; currently, there are four weightings for combined courses in physics and mathematics. Degree courses attractive to employers are encouraged; thus, a physicist who wishes to apply his knowledge in biophysics may take some units in biology or biochemistry, a biochemist interested in macromolecular structure may take a course in computer programming, etc.. In the latter course, there are α and β alternatives in each year, with some overlap between the years, so allowing a student to study more difficult courses in topics he is good at. A system of credits is based on time spent on a course together with its difficulty level.

Thus these courses, like those at Keele and Sussex, are in line with recommendations of the Robbins Report that a greater proportion of undergraduates should receive a broader education and that, wherever possible, the decision between special and general courses should be deferred to the end of the first year.

What 'assessment' of courses there is, in British Schools, consists in inviting students to express criticisms or to make suggestions during staff-student conferences or by way of questionnaires. The use of questionnaires is becoming more common in London's Medical Schools[11] and an opinion poll on lectures, prepared by dental students, has been reported in a supplement to their School journal[93].

If asked to define their aims university teachers usually include general aims such as encouragement of 'scientific attitude', capacity for critical thinking, independence on the part of students, and so on. Evidently what these teachers hope to achieve is transfer of attitudes and skills developed in their own field to other situations in life; but studies in America suggest that this may rarely be achieved. The only one of these studies recorded in a partly British journal tested for changes in political knowledge, participation and values resulting from courses mainly in social sciences, but there was little evidence of any impact in these respects.[65]

In two inquiries into the aims and choice of teaching methods among twenty one teachers in a department of psychiatry, Walton and Drewery found widely different aims.[103,104] It is true that every teacher stated as one of his objectives the provision of systematic information, but this was the exclusive goal of three of them, six others taught with a psycho-dynamic orientation, seven shared these goals but also aimed to teach behavioural science while the remaining five aimed, in addition, to modify the behaviour of students. Hospital staff lecturers and teachers with a unidimensional subject orientation tended to have aims of the first two, the differences between these groups being significant. Aims were less clearly related to choice of teaching methods than to the teacher's speciality, but those most in favour of group work emphasised teaching for students' self-knowledge and viewing patients in the family context.

The revelation of such a diversity of aims within one department stresses the need to state overall objectives of a course and suggests that considerable discussion might be needed before the introduction of major changes requiring all members of staff to accept aims wider than provision of information. Indeed, discussion would probably show that members of staff had different interpretations of 'systematic information'; or they might disagree as to methods of determining whether this objective had been attained. Similar comments apply to most of the objectives we quote below except those spelled out in detail for programmed courses.

Differences in aims may also be expected between teachers of different university subjects. In a pilot inquiry into the use of small group discussion in departments of mathematics, electrical engineering and biology in London University[10], lecturers in any one subject had many different aims in using discussion but there was also some differentiation between subjects. The aim mentioned most frequently by mathematicians and engineers was to discover and to discuss students' difficulties; mathematicians mentioned this thirteen times, engineers ten times. The biologists showed a different emphasis giving as their most frequent aims: to encourage critical thinking, to look afresh at familiar problems (8 times), to explore other subject matter or an individual topic (8 times) and to encourage reading (5 times). Some of the engineers also mentioned increase of activity on the part of the student with moderate frequency: to encourage active participation (5 times), to stimulate students into thinking and reading (5 times) and to develop ability to speak fluently or to make verbal reports (5 times). The table shows an analysis of

aims for each subject into three categories: provision of aid to students in difficulties, stimulating some kind of independent activity, or 'other'. The last category includes aims such as: "to reduce routine lecturing," "to give opportunity to investigate in depth aspects of a course which is brief and therefore shallow", "to provide more intimate and personal staff-student contact" and so on.

Aim	Mathematics	Electrical Engineering	Biology
To aid students	28	25	15
To encourage independent activity	10	23	28
Other	9	8	5

The clear difference in emphasis, on giving assistance or encouraging independent activity, raises questions which cannot yet be answered with any certainty. For instance: does difference in subject matter wholly account for it? Mathematicians might argue that independent activity and critical thinking were essential to even modest success in their subject so that removal of difficulties automatically gives rise to both. In biology, however, a weak student may be satisfied if he reads uncritically and reports information directly from a textbook; he is not brought face to face with his inadequacies as a weak student in mathematics is when he fails to solve problems. In addition, living things differ in their behaviour on different occasions, so a biologist must be trained to be critical of a single experiment or of a few experiments. Apart from these differences in subject matter, aims are likely to differ with the age and seniority of the students. In mathematics, most discussion groups were held with first-year students; in biology, second-year students were best represented but group discussions for third-year and postgraduate students were also more numerous than in mathematics. At higher levels we should expect students to be led increasingly to independent activity. A third possible cause of difference in aims between teachers in these two subjects may be the work of Abercrombie, whose book The Anatomy of Judgment is based on work in a biology department and shows the use of group discussion in promoting critical thinking.[1] It is likely that this is better known in biology departments although it seems reasonably certain that her findings have wider application.

Intermediate aims of various kinds are of great importance in giving direction to learning and in promoting confidence and motivation by their successive achievement. This is one aspect in which the contributions of psychologists and others designing objective tests or writing programmed books are so valuable, for they break down the ultimate aims of a course into many intermediate objectives. A few examples will serve to show the value both to a student who wishes to learn, or to revise, independently and to the teacher. In the first place, two aims provided by Mr. E.A.H. Martin (Department of Botany, Glasgow University) are broken down in this way:

A. Aim: "To understand the Hardy-Weinberg Law"

Objectives:
1. The student will be able to give a written definition of the law
2. The student will be able to derive the Hardy-Weinberg formula
3. The student will be able to list four conditions described in a population before the gene frequencies given by the formula will be valid.

B. Aim: "To understand sex-linked inheritance"

Objectives:
1. Given several family trees, the student will be able to select those in which there is a sex-linked trait.
2. The student will be able to forecast the percentage of affected individuals of a mating, given the genotype of the parents.

It is possible that if the reader teaches biology he has now remarked that the objectives listed above are more or less those which he would in any case follow and that there is, therefore, no particular value in outlining what is so obvious. If so, it may serve a useful purpose to list a second set of objectives broken down in a similar fashion, this time in electrical engineering (provided by Mr. J.B. Thomas, Brunel University).

Aim: "To understand magnetohydrodynamic power generation (MHD)"

Objectives:
1. To give a brief but accurate account, in descriptive terms of the basic physical principles of MHD generation.
2. To draw a sketch which illustrates unambiguously the reasons for the MHD power generation, in terms of the movement of hot ionised gases through a magnetic field, etc.
3. To list the practical problems arising from the high temperature required for MHD generation.
4. To list, compare and contrast, the advantages and disadvantages of the open and closed cycles for MHD generation.
5. To discuss the forecast of the economics of MHD generation in terms of -
   5.1. capital expenditure and running costs of MHD plant,
   5.2. 'topping up' conventional steam plant.

In addition to the provision of intermediate objectives such as these, short term objectives play an influential part in certain kinds of learning and teaching. In programmed learning the short term objective of the learner is to give the correct answer to the next frame; in following a logical argument the student may try to decide the next step before it is spoken or written; and, in learning from tapes or slides, the immediate objective may be to give a correct answer to the next question. In every case it is crucial that the answer should be given almost at once so that a correct response is reinforced and a wrong one immediately corrected. Where the objective in teaching is learning of information or understanding and application of principles short term objectives of this kind can add considerably to the efficiency of learning.

In certain kinds of learning there is no need to supply an answer since checks are intrinsic; when learning to type, or in rote-learning vocabulary, for example, the learner knows at once that he has made a mistake and what to do to correct it. In such a case learning is likely to proceed rapidly; but in many kinds of higher learning students require to be told whether they are right or wrong and this must happen before learning can proceed further. It is in such tasks that it is important to provide students with fairly rapid feed-back on their success - by providing questions and lists of answers, outlines of solutions etc., or by making comments on exercises - since in this way they are motivated to learn more rapidly. Experiments have been described, even with post-graduates, in which questions requiring written answers were introduced during a lecture and immediately corrected, which resulted in greater enthusiasm and markedly more rapid and effective learning[10].

A comprehensive approach to defining objectives in a course, using all these methods, as appropriate, has been made recently in an Art College[116,146] which employed an occupational psychologist. Analysis of the work of designers led to discarding the traditional subject-based course in favour of one aimed to develop abilities in solving design problems, to provide a knowledge of the context in which designers work and to enable students to learn to establish relationships with management. The aims of the course are described, therefore, in operational terms, showing what students should become capable of doing at various stages. These aims and the related performance requirements are set out in extensive charts which serve as a 'syllabus' and 'timetable' both to staff and students. The course is associated with a different attitude to students' learning. From the beginning, students are asked to think about problems, and teaching staff cease to give factual information but guide students to use their own expertise and to obtain necessary information in the course of solving problems.

Methods of occupational psychologists have also been used by designers and architects[114,119] and by physicists in planning a lecture course and in preparing a guide to the postgraduate education of physicists. Williams and Wooding[163,164] used net-work analyses to set out in diagrams the activities involved in a lecture programme and in planning a research. This involved analysis of the activities involved, showing the order of events and the relationships between the activities; drawing the net-work entailed and defining the objective of the programme, setting out the successive activities to attain the objective and making estimates of the time required for the completion of each activity. This kind of presentation permits greater generalisation of the material and displays omissions or redundancies. Two net-works, in a series of six, show how each task is attempted (figures 1 and 2). But although this approach will lead to greater efficiency it will not, of course, help to overcome the complaints concerning some PhDs, reported by the Institute of Physics[133], that they lack scientific originality, a good theoretical background in physics or flexibility and adaptability in thinking.

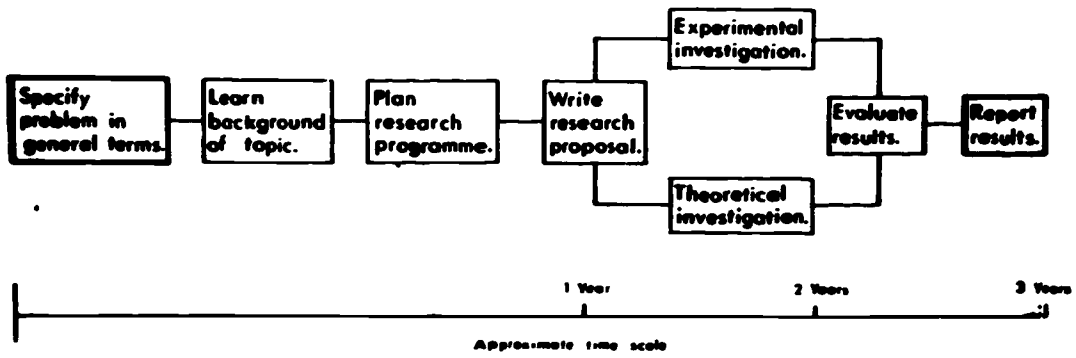

Figure 1. **Overall plan of research project.**

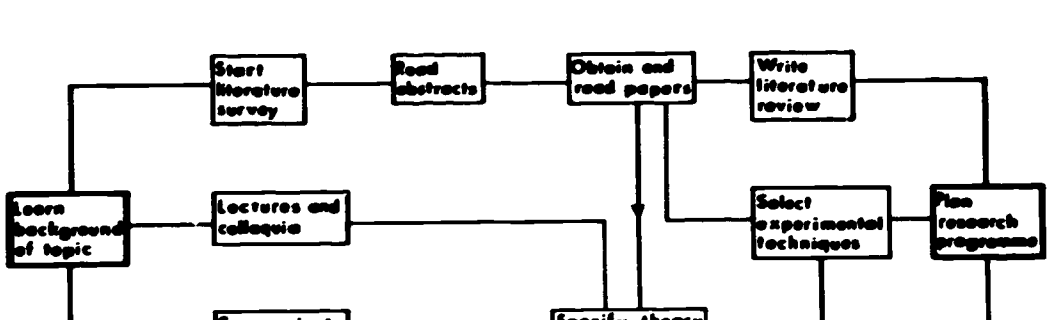

Figure 2. **Activities involved in learning the background of a subject.**

ECONOMY AND EFFICIENCY

Under this heading we shall consider experiments in which one important objective was to reduce time occupied in teaching by increase in class size, absence of the teacher for part of the time, or by reorganisation of teaching. But it is of interest that economists are now beginning to investigate efficiency and productivity of university education[113].

Only two experiments described in British journals are specifically concerned with class size: de Cecco[19] assigned 682 students randomly to three kinds of groups, 2 large experimental ones consisting of 97 and 127 subjects, 6 small experimental groups ranging in size from 18 to 34 subjects and 10 small control groups ranging from 22 to 35. All courses in the experimental groups followed the same outline including major assignments, instructional materials and a common grading system but, in the control group, instructors proceeded as normal, selecting their own materials and creating their own assignments. In the four tests given subsequently, no significant differences were found in acquisition of information or understanding but the students greatly preferred smaller groups.

Cottrell[17] used groups of 3, 12 and 24 members in an attempt to discover how large a discussion group could be in physical chemistry without loss of efficiency. A short answer-paper was set on matter of fact and simple problems following weekly discussions throughout one term. Groups as large as 24 proved unpopular and inefficient but the success ratio (calculated by dividing each student's score by his mean marks in class examinations in chemistry the previous year) was consistently higher for the groups of 12.

Extensive studies on class size made in the United States, having somewhat conflicting results, are reported by McKeachie[66] who concludes that the importance of size depends on educational goals: "In general, large classes are simply not as effective as small classes for retention, critical thinking and attitude change."

Programmed learning is another recent development which offers the tutor an opportunity to reduce instruction time. A series of experiments to compare programmed learning in science with conventional teaching, at the same time using only one trained instructor where formerly two were employed, has been made very successfully in the Navy.[90] Ten pairs of classes were taught by conventional methods or by programmed learning in basic electronics, basic radio and in associated laboratory work. While one group followed the programme and illustrative films with the aid of a junior technician, the other received conventional teaching from an Instruction Officer. Since in every case results from programmed learning equalled or excelled those of conventional teaching it was clearly possible and indeed even beneficial, to cut instruction time by half. Failure rates were 14 per cent and 3 per cent less and final average marks were 62 in each case as compared with 55 and 54, in electronics and radio respectively. In addition time taken by programmed learning in radio

was 25 per cent less, on average, than that for conventional instruction. Experiments in the RAF confirm that, when used over a period of weeks, students using programmed learning took considerably less time, particularly in the case of those using a programme reduced to essentials, but achieved results similar to those of apprentices studying by conventional methods[102].

In industry, Romiszowski[152] reports that about half the large industrial firms now use programmed learning. Education officers find that it results in better retention, faster learning and flexibility in teaching since it can proceed without supervision. Adult students find programmed learning less embarrassing than class teaching since they do not need to admit ignorance in public. In addition, the results are continuously assessable and controllable.

Criticisms are often made of experiments in programmed learning on account of their brevity, inadequate testing of the programme or poor quality of teaching compared with the programmed learning course. Almost all of the experiments quoted in this article, however, were of fairly long duration, covering whole courses in a number of cases; the programmes were carefully tested and teaching, compared with the programmes, was of a high or unusually high standard, based on the content of the programmes themselves.

It may be that findings in the Forces and in industry are irrelevant at university level but only experiments with carefully prepared programmes can show whether this is so. However, Moore[145] found in an experiment with university students that group teaching by a method of pacing, setting a time limit for each frame, resulted in a considerably better speed for slow workers. Times for the machine group were of the order of 30 per cent less than that of slower workers using self-paced books. This saving was effected without significantly affecting the test scores. Teather[158] in listing programmes for teaching biology notes the saving in time and the possibility of using programmes for experiments with alternative teaching sequences.

Comparisons of different conventional methods of teaching show that the lecture is more economical of time than other methods if each is used independently.

Joyce and Weatherall[53], in comparing different methods of teaching (lectures, discussion groups, practical classes and unsupervised reading) in a carefully designed experiment, concluded that lecturing was the most efficient method of teaching since it used least of the students' and staff's time: "For tutors the size of classes is relevant to the economics of teaching, and the figures amount to 0.05 hours per session per student for discussion groups of 12 students, and 0.33 hours per session per student for practical classes on the same scale.... these estimates are probably reliable enough to emphasise the economy, both to students and staff of lecturing compared with practical classes and discussion groups....". But they commented that a simple comparison of the four methods might not have shown all of them to the best advantage: for example, discussion groups might have been more efficient when used to develop material already presented by other methods.

In a second experiment[54] they used a more complex, but equally carefully chosen design, to compare methods in which the contribution of teachers' time

was small with others in which the teachers were more fully involved. Sixty-two preclinical students were taught by four initial lectures and either three demonstrations or three practical classes in conjunction with either three conventional seminars or three discussion meetings initiated by playing back recorded material. Gain in knowledge did not differ significantly from one group to another, but demonstrations were much more economical of time than practical classes for teachers, technicians and students (practicals taking about 20 per cent more time for students and teachers); discussion required less time of teachers than seminars, but the corresponding difference for students was slight.

MacManaway[141] confirmed the efficiency of lectures in comparing recall of lecture material and the same material learned by reading lecture scripts and note-taking. Reading and note-taking took considerably longer, but, in a test given a week later, students in both groups did about equally well. A third group who attended the lecture and made notes subsequently took still more time but did no better.

One experiment, however, shows that combination of methods, using some discussion but no lectures, may be highly efficient. To Erskine and Tomkin[27], reduction of time spent on a course was a major consideration. They substituted two periods of group discussion for nine lectures during a period of three weeks spent in studying the anatomy of the pelvis. Following an introductory demonstration using specially prepared specimens and models, practical work was done in the usual way, but with access to practical materials at any time during the day and with informal demonstrations on request. The discussion groups were introduced at the ends of the second and third weeks. On each occasion lists were displayed which drew attention to a number of points in the course of practical work, and a central theme was agreed on for discussion between the four instructors in order to organise the facts into a pattern. Consequently the students arrived well prepared at the discussions, in which there was a free exchange of views resulting in synthesis at the end of each section.

The experiment was not a controlled one in which parallel groups were treated differently, but an attempt was made to assess its success by comparing results of students in two successive years, and each group of students with themselves in anatomy of the pelvis and of the thorax. Objective tests, essays and oral examinations were all used in the assessment. It appeared reasonably clear that there was no loss of information as a result of the change in method, but rather the contrary, and students who attended discussion groups were far more successful in oral examinations. But the chief gain was of 7 hours time in the case of each student and 1 hour to each member of staff.

In this last experiment we have evidence not only of reduction in time spent but also of better recall of recently learned material. Experiments with programmed learning have also resulted in gains in both these respects, but at present there are few programmes suited to university work. However, where recall, or retention, is as good as that for lectures or other methods depending on the presence of teachers, the gain in teaching time is obvious.

Detailed studies of the uses of students' time over a period of a day or, more probably, a week, give a useful indication of the pressure or slackness of work, attendance at voluntary courses or other activities, etc., and so provide a basis for changes in the curriculum or, possibly in teaching methods. In an early study of this kind Thoday[159] asked each of over 500 students in Birmingham University to account in detail for his or her activities on the previous day. Information was also obtained about main activities during the previous weekend and a proportion of students were interviewed twice to give some idea of day-to-day variations. She found that mean time spent in work per day was $6\frac{1}{4}$ hours; $3\frac{1}{2}$ hours in time-table work and the remaining $2\frac{3}{4}$ in 'informal work'. Contrary to belief, female and science students worked no harder than male or art students, but the latter did more informal and less set work. Second year students worked least hard except those studying medicine and modern languages who had important examinations then. In most subjects students did more work in the first than in the final year.

Recent studies are far more detailed. Students are asked to account for time hourly during the night and quarter hourly during the day and to fill in their schedule using code numbers for different activities during one week. Mean times may be compared with estimates provided in advance by teachers. In one medical school[107], clinical students proved to be working 40 to 50 hours per week but preferred to take more leisure throughout the week and to work during part of the weekend; the first years averaged 7 hours per day, while second years averaged 6 hours. Teachers estimates corresponded fairly well with average times given to different activities by students except that they supposed students talked shop more than they claimed to do and that they spent far less time in leisure activities than, in fact, they did. The authors concluded that the failure of students to work hard suggested that the course could be more challenging.

In an unpublished study in another clinical department a similar questionnaire was completed and a sample of students were also observed throughout a period of three weeks. Staff supposed that the first year students would spend some 7 to 8 hours per day in the wards or in study, but their mean times in the hospital proved to be 4 to 6 hours daily including lunch-hour, and with little evidence of additional work. In the observer's opinion the students felt insufficiently involved, at least during this period, to work hard in their clinical course.

RECALL AND RETENTION OF INFORMATION

Experiments Based on the Findings of Psychologists

Methods of improving immediate recall, or of retention, of subject matter are based on what is known of remembering and forgetting in learning. It is known that to assist memory subject matter should be meaningful, inter-relationships between topics should be stressed, and frequent short periods should be spent in study in preference to a few long ones. Forgetting on the other hand, is induced by presenting the learner with many unrelated details, or by interference where a new topic is introduced at the end of a period of study or if two closely similar topics are learned together. To encourage accurate recall, correct responses should be rewarded, or reinforced, immediately (possibly only by knowing that the response is right) while wrong responses should be corrected at once. It is commonly said that errors should be avoided as far as possible. Above all, it is important that the student should make a response, though it may be a purely mental one; to be efficient, his learning must actively employ his ability to organise new information into his existing mental schemes. Where learning takes place by rote, with little understanding, subsequent forgetting is rapid. Obviously interest is also important; a student who is interested is more likely to play an active part in teaching himself.

Studies in which principles are stressed while details are reduced in number take account of these findings. Erskine and O'Morchoe compared recall following a course in anatomy in which principles were stressed and details omitted with one of the same length in which details were included. [26] But although results appear to be consistent with findings in the psychology of learning, the experiment was performed with groups which were not strictly comparable, since they were in different years and were, presumably, taught by different teachers.

Adams et al. made a controlled study into the value of emphasis in the elimination of errors, collecting common errors, testing them on a group of 53 students, and dividing them for the purposes of the experiment into matched groups.[3] For the next few months in the experimental group each misconception was deliberately discredited whenever it was relevant to mention it, while misconceptions in the control group received no special attention. At the end of the course, incidence of misconceptions of the experimental (emphasised) items had decreased to a highly significant amount as compared with incidence of misconception in control items. Thus there was no support for the common belief among teachers that emphasising errors leads to their perpetuation.

An unexpected finding in this experiment was that the students who attended best had the highest incidence of misconceptions initially. The best attenders showed substantial improvement during the course both on treated and untreated items; moderate attenders improved only on treated items, and the poor attenders showed little improvement, what little there was being mainly in the treated items. Broadly, this provides evidence that the first group were probably the most intelligent who were sensitive even to slight emphases. The

writers consider of special interest that this group of students "entered the experiment with the highest incidence of misconceptions and finished with the lowest - that is, the best learners went through a phase of putting forward the selected misconceptions unusually readily". They suggest that this points to a trial and error mechanism of learning, lending support to the saying "If you don't make mistakes you won't make anything".

Some light is cast on the seeming contradiction in this experiment (to the belief that it is unwise to emphasise errors), from the results of an experiment by Elley who contrasted the effect of errors in rote and logical tasks.[24] He used multiple choice questions allowing different rates of error in the course of learning each task. In rote learning, frequent errors resulted in inaccurate recall but, in logical tasks, the rate of error made no difference for, in these cases, students did not tend to repeat errors which they happened to have made while learning. Elley comments that, in preparing programmed texts for students on meaningful learning tasks, there is no need to be restricted by the assumption that errors must be kept to a minimum due to the interference they occasion in learning. However, in simpler tasks such as acquisition of vocabulary and elementary use of language, methods which lead to error-free learning are the most effective.

Avoidance of interference due to the order of presentation of learning tasks was studied by Leith and McHugh.[60] The questions they wished to answer were whether it was preferable to present a familiar task first, following it with an unfamiliar one as is usually advised by teachers, or whether the reverse would result in more effective learning and, in either case, where to introduce a theoretical passage explaining the subject. Students studying anthropology were given three passages: kinship systems of patrilineal and matrilineal tribes and a theoretical passage explaining the significance of kinship and different patterns of marriage, descent and residence. The design of the experiment allowed eight treatments with 80 students; the passages were studied during three 45-minute sessions in one day and a test containing items from all three passages was administered two days later. Analysis of the results showed that students did equally well in questions relating to the familiar, patrilineal system whatever the order of presentation, but they recalled the matrilineal system significantly better if it was presented before the more familiar system, and theory was helpful only if it came between these passages or at the end.

The importance of activity on the part of the student is, of course, one of the tenets of psychologists who design programmes for machines and programmed books. Like all psychologists of the associationist school they reject all introspective concepts in studying learning and concentrate their attention on change in behaviour. They describe learning as built up by reinforcement of responses to stimuli from the environment though these may, of course, be consequent on the learner's activity. It is therefore not necessary that the learner should wish to learn but only that he should be encouraged to follow a logically organised sequence of stimuli, feed-back as to his success serving to reinforce correct responses. However, the recent introduction of the term

'effective stimuli' for those relevant to the needs of the learner and 'non-effective stimuli' for those which are not makes some allowance for what the field psychologists call 'motivation'. A number of studies show that programmed learning is at least as effective as traditional teaching. We have already mentioned saving in teaching time and more efficient recall as a result of programmed learning in the Navy and Air Force. Also, a notable increase in retention of information, giving a 49 per cent lower failure rate for the programmed learning group in an examination of the Royal Canadian Air Force was found by Farrell[28]; but in these cases the topics were fairly elementary. Yet at university level, it appears to be almost as successful. Croxton and Martin[18] replaced courses in Strength of Materials and Theory of Structures by two series of short programmes together with problems and tests to follow each programme. Their students preferred being taught both subjects in this way finding them fairly easy whereas formerly they were among the most difficult subjects, but they wished contact with the tutors to be maintained, and desired a measure of competition with other students. Performance in sessional examinations was somewhat better than it had been with conventional teaching. Stones[92], who experimented with programmed learning to see whether supervision, working in a group, or working to a set time influenced results or attitudes, found no differences between five groups except that students working independently took more time, probably because they lacked the stimulus of competition.

Glynn[36] and Hoare and Inglis[44] used teaching programmes in chemistry with H.N.C. students and 1st year M.B. students respectively. The H.N.C. students liked the method and did well in compulsory questions in their examinations, weaker students showing the greatest gains. The majority of the 1st year M.B. students reported that they found their programmes useful, or very useful, for increasing comprehension, revision and answering problems and the class as a whole did exceptionally well in the organic chemistry examination. Glynn made use of both linear and branching methods. (A linear programme is a single ordered succession of frames - usually statements with a word missing - and proceeds by very easy stages. The answer to each frame is provided either at the beginning of the next one or overleaf. Since there is no provision for the correction of errors the programme must necessarily consist of short steps which are easy to answer correctly. A branching programme offers a choice of answers, students proceeding to different frames according to the answer they choose. They are told whether they were right or wrong and why; thus they proceed by different paths and at different speeds. In the branching programme frames may be fairly long.) Guild[127] has reported the successful use of a programme for individual teaching in dentistry.

Owen et al.[72], in a more carefully designed experiment, compared a branching programme in teaching electrocardiography with a course of lectures specially prepared to correspond closely with the programmed material. As a result they found no difference in mean scores between method and academic ability and between sex and method. Less able students profited most from using teaching machines but the women in this group did better when taught by lectures. The majority of students preferred machines to lectures but overall

the two groups spent about equal times in study. Poppleton and Austwick[74] compared a programme in elementary statistics with reading and note-taking but found that the learning of pairs of matched students was about equally effective by either method.

Evidence that learning from programmes in paragraphs can be more effective than learning from brief frames was obtained by Wright[166]. She designed an experiment in which undergraduates worked through a section of a programmed text on psychology prepared in one of four ways: in short frames with blanks, paragraphs followed by questions, or frames or paragraphs with answers filled in. Completed frames proved significantly more effective than those with blanks, and paragraphs were significantly more effective than frames, paragraphs with questions being by far the most effective. She suggested that the structure of this material was more clear in paragraphs.

A different kind of inquiry using programmed learning was made by Leith and Buckle[59] who studied the effect of overt or covert responses to frames in relation to difficulty of material. Following the use of a programme in electronics with three groups of students (formed on the basis of prior knowledge: A-level physics at least, O-level at least, or little knowledge of physics), they concluded that the more difficult the task was to the learner the greater was the need for overt responses. But, in line with the well known findings that rote learning is more efficient when it takes place vocally rather than mentally, they found that overt responses were, in general, more effective than covert ones. This is an interesting finding in view of experimental results with younger children. In their case, Piaget has observed[73], and Slavina[85] and Galparin[33] have used in teaching, a gradual internalisation of information or concepts from use of concrete materials with instructions spoken out loud, whispered, then thought, and, possibly, in a final stage forgotten, as a successful operation is carried out. When the level of difficulty is sufficiently great it seems that adult students too may learn more efficiently if they respond overtly at first, gradually internalising their responses.

The use of continuous feed-back as to the success of learning is likewise an essential feature of programmed learning. But prompt and frequent feed-back is recommended almost equally by other psychologists as an aid to recall and retention of information. Asking questions of students during the lecture period to which they must write the answers, and providing correct answers immediately proves to be an extremely effective method of teaching.[11] Applying information is also an aid to retention. McLeish found that students recalled only 42 per cent of the content of a lecture immediately afterwards but, if they received a copy of the lecture and applied its contents soon after hearing the lecture, they retained three quarters of what they had learned after one month[140].

The importance of activity on the part of the learner is a principle of learning as it is described by the field psychologists; but, unlike the associationists, they describe learning in terms of the individual sizing up, or interpreting, his world in a way that is meaningful to him, integrating experiences into existing organisations of knowledge and using the environment in ways

advantageous to him. It follows that what the individual perceives is selective. In teaching, therefore, field psychologists are concerned with motivation, stress the importance of arranging that learning experiences are organised into meaningful wholes, and favour the use of problem situations which enable the learner to gain 'insight' as he suddenly realises how to use information or how to interpret it meaningfully. In addition, the learner may develop and follow his own goals. Their more self-directed, problem-centred approach may be thought of as most suited to practical laboratory work or in teaching students to work independently by providing problems or topics for them to study alone; but it also aids recall and retention of information, probably because in the course of the student's activities he integrates information meaningfully into what he already knows so making it easier to retrieve when it is needed since many bonds have been formed with other knowledge. Holland et al. used[45] practical experience to make clinical students aware of social and emotional aspects of medical care by assigning each student in the experimental group a patient from the ante-natal clinic to visit and attend during the following seven months. These students also prepared reports on such topics as family size by social class within the area, etc., while the control group followed a conventional course. In a multiple choice test given unexpectedly, both groups did about equally well in clinical obstetrics but the experimental group was significantly superior in knowledge of social medicine.

It is relevant here that one of the main criticisms of the lecture by medical students is that it is a passive method of learning[14]; many of them wish a large proportion of lectures to be replaced by teaching methods allowing more student participation and, in the lectures that remain, they advocate a more extensive use of audio-visual techniques so providing for simultaneous auditory and visual learning.

In contrast, there is some evidence from recent work of the value of relaxation in learning. Repin and Orlov[149], reporting experiments in an Australian Journal, claimed that when 2 - 3 hours were allowed for conventional learning some 70 - 80 per cent of 50 new English words were recalled on the average immediately afterwards, with a range of 40 - 100 per cent; but, in a state of relaxation, 20 minutes sufficed for students to attain scores of 80 - 88 per cent and, after a further 5 minutes of visual rehearsal this rose to 92 - 98 per cent. 3 months later 90 - 94 per cent of words learned in relaxation but only 50 - 60 per cent of words learned conventionally, could be recalled by the students. Special suggestion to memorise improved performance further. The editors comment, however, that it is difficult to assess the experiment as full information is lacking and there were no statistical tests.

The Lecture

Function

Inquiries in connection with the Hale Report [96] show that the views of university teachers in Britain on lecturing are more favourable than those in the medical students' report [14]. Most of them believe that students are too immature to study independently and that lectures are the most economical way of communicating information to them. Scientists, in particular, regard the lecture as an excellent way to introduce and to open up difficult topics which students cannot undertake on their own, while it is generally felt that the lecture is the only solution to a paucity of books or rapid developments in subject matter which outdate existing books. Nearly all teachers claim to cover the syllabus in broad scope and principle, using only sufficient illustration for the principle to be understood. They point out also that they can respond to the students in a way that teaching aids cannot, that they are able to show their students how to organise a topic or how to build up a complex argument or diagram, and that they can share their enthusiasm for the subject, include discussion of recent developments or indicate topics for further inquiry.

The comments of students consulted in Marris' inquiry [70] that they desired lectures to be clear, orderly synopses, logically planned, emphasising basic principles and with not too many digressions, and that time should not be wasted in imparting the contents of the text-book, suggest that lecturers may be less successful than they believe in using lectures to impart knowledge in these ways. The high percentages (over 40 per cent.) commenting adversely on delivery and clarity of exposition tend to confirm this. On the other hand, there is evidence that some students share the lecturers' more favourable view of the lecture. In the study by Joyce and Weatherall [54] comparing four methods of teaching, the students considered lectures outstandingly the most useful, demonstrations following some way behind, with seminars a close third and practicals a close fourth. But students of the Royal Dental Hospital School of Dental Surgery in their opinion poll on lectures showed less agreement. [93] There was no consistent view as to the value of lectures nor as to how courses might be improved. The only conclusion which could be drawn with confidence from this part of the inquiry was that more lectures would be unpopular. There was no doubt, however, that students of the School expected lectures to fulfil three functions: to introduce the subject and set it in its context, to bring the text-book up to date and to provide discussion of problems and their possible solutions.

Maclaine [63], in surveying teaching methods in Australian universities, grouped the advantages and disadvantages under these headings: motivational, organisational and informational-elucidatory. In addition to listing most of the points made in the Hale Report he included under the first heading exploration of desirable by-ways, under the second, guidance in reading and evaluation of text-books and, under the third, "to explore and clarify ideas and techniques." But an adverse effect of the comprehensive course of lectures in an Australian university school is mentioned by Schonell, Roe and Middleton [82] who comment that although teachers may sincerely believe that their lectures serve as a guide

to reading they are, in fact, used by some students as a wholly self-sufficient course of study; in their survey, 15 per cent of Queensland students relied almost entirely on lecture notes and the majority of students studied primarily from them.

Whether lectures should be compulsory or not is a matter to be decided consistently with the aims of the School or department. In some Schools encouragement of independence in students is valued so highly that some inefficiency is countenanced as a result of absence; but that absentees from lectures do less well in tests and exams. than those who attend has been shown in several studies.[3,47] Where it is impossible to make good the loss of information in lectures, compulsory attendance would generally be recommended.

Place and Length

The place of the lecture differs in the various Faculties. At the time of the Hale Report, in 1964, Arts faculties used mainly lectures and discussion groups, with reading, whereas in the Science faculties there were more lectures with practical or laboratory periods but comparatively little discussion. In Arts the average weekly hours spent in lectures were 6.8 from a total of 10.1 hours of instruction, in Pure Science 8.3 of 17.3 hours and, in Applied Sciences, both lecture time and total time spent in instruction were still higher viz. 10.7 and 19.6 hours.[96] During the last few years, however, there has been a considerable increase in the use of small discussion groups in departments of science and mathematics.[10]

In Law there is a similar trend. A recent survey of legal education shows that the majority of lecturers agree that some lectures are essential but they would welcome the extension of the tutorial system to at least two tutorials per week.[105] They also consider that students should have more opportunity to sample law in action in courts and solicitors' offices, subsequently discussing their visits.

There is little experimental work on the lecture from British sources. Holloway[47] compared recall of information in dentistry among groups of first and third-year students attending lectures at 9 a.m. or 4.30 p.m. Analysis of scores in two ways, comparing students with themselves on different occasions, or students with each other in the same test items, showed significant superiority for classes held in the morning.

McLeish[64] was interested in the problem whether students listening to only the first twenty minutes of a lecture would remember more of it than those who were present for 40 minutes or one hour due to interferences set up by later material. He used three experimental groups who attended different lengths of lecture and a control group who did not attend. Overall the experimental group recalled 42 per cent of what they had heard as measured by an objective test immediately afterwards, but the hypothesis that there would be loss of recall due to retroactive interference was not borne out. This may perhaps be explained by a difference in content of the three parts of the lecture but further experiment is needed to determine in what ways later material may vary before

it causes retroactive inhibition. In the experiment by Trenaman, quoted by McLeish, listeners to a 45-minutes talk on Astronomy assimilated appreciably less after the first fifteen minutes and, after thirty minutes, ceased to take in anything additional or forgot what they had memorised earlier. However, it is impossible to generalise from the results of a single experiment of this kind even if we know the subject matter, the manner of presentation, and the difficulty of the subject to the participants.

Observation suggests that a lecture given at a suitable speed in mathematics or certain science topics, in which a logical presentation is written on the blackboard, provides constant opportunity to the student to obtain feed-back on his understanding of the topic; for, unless the speed is too great, he can work out the next line just in advance of the lecturer, obtaining confirmation, or correction, so soon as that line is written. Inability to obtain reinforcement in this way is probably the chief cause of frustration when the lecturer proceeds too fast or presents material in a disorderly fashion.

Delivery

There does not appear to be any British experimental work on techniques of delivering lectures; but views expressed in inquiries have some interest as there is often a high level of agreement. Students of the Royal Dental Hospital School of Dental Surgery comment[93]: "a lecture has to be delivered very very slowly indeed before the speed is found to be too slow but only a moderate increase in pace will produce complaints of 'too fast'." However, they remark on inconsistencies in views as to suitability of speed in delivering orthodentics lectures: 44 per cent of the 4th year, 7 per cent of the 5th year and 80 per cent of the 6th year find the speed unsuitable; possibly this reflects the anxiety of students at the approach of an examination, but it may also be affected by the difficulty of the subject at each level, and perhaps suggests that speed should vary inversely with difficulty of material. But this could be the subject of an experiment.

It is generally agreed that a lecture is more effective if it is spoken freely rather than read and that repetition is helpful in aiding subsequent recall. It is also advantageous to supplement the spoken word by visual aids where these are relevant; for, since auditory and visual impressions are received independently in the brain, their simultaneous presentation does not set up interference but, by offering alternative methods of recall, makes learning more efficient.

Evaluation

It is not easy to evaluate a lecture, taking into account all its objectives, and it would probably be undesirable to attempt to evaluate each lecture of a series. Nevertheless some evaluation appears to be worthwhile. Few of the heads of departments consulted as to the success of lectures in an Australian inquiry were satisfied that objectives were achieved[6]; they commented that lectures tended to succeed with certain students but not with others or that lectures were more successful in certain subjects than in others. Whereas

these differences seem inevitable, students complain of basic faults such as poor preparation, that lectures are neither clear nor systematic, so ill-delivered as to be barely audible, or that they are addressed to the professor's notes or to the blackboard. Others report lectures delivered so rapidly that they cannot be followed coherently, consisting of a mass of detail, or presenting a difficult argument in a fashion which only the most able students can follow.

Despite these varied criticisms it is probably true that almost all lecturers sincerely desire that their lectures should be well delivered and readily comprehensible. Failure in these respects is often unconscious and students of undergraduate age often fail to provide the hints, or outspoken criticisms, which would result in improved practice on the part of the lecturer. In the belief that most lecturers would welcome any means of finding out to what extent they were successful, a group of scientists working in a research group with the University Teaching Methods Research Unit of the University of London Institute of Education prepared a questionnaire for use by students. They invited them to agree with various statements, on a 5-point scale, relating to the lecturer's audibility, speed and quality of delivery, appearance, manner and rapport with the class and to aspects of presentation of subject matter or use of audio-visual aids as well as to comment on surroundings and other factors influencing the success of the lecture. It is of interest that even among these enthusiasts it was not until nearly a year later that any of the group agreed to use the questionnaire; for, as one lecturer said: "It will only give the students an opportunity to make satirical comments." Yet when it was tried at the beginning of courses enthusiastic reports were sent in. A veterinary scientist reported that his students "seemed grateful that something was being done" and that they combined to give a joint criticism and made useful suggestions. An electrical engineer[67] tried two forms of questionnaire with small groups; he discovered that there was more extraneous noise than he had supposed and that on changing from lectures with notes to lectures without notes he had not slowed his pace sufficiently; he received confirmation of information obtained in earlier surveys that his students liked duplicated notes and coloured diagrams since they found the latter clearer than the blackboard and the former enabled them to concentrate better on the lecture. A biologist received approximately an 80 per cent response from a large class and felt that it had been particularly valuable to receive criticisms and comments at the beginning of a course since it enabled her to adapt her teaching to their needs in the remaining lectures. Although this technique does not inform the teacher how much the students are learning, it does establish better rapport and almost certainly results in more efficient teaching.

This is one satisfactory method to use but it is not the only one. Among methods reported within the University of London are the following: taping a lecture and listening to it subsequently in private, taping a lecture and observing in the next class while they listen to the recording, inviting students to provide immediate feed-back on the lecturer's success by complaints as to excessive speed, lack of explanation of difficult points etc. and, in a few cases, lecturers invite colleagues to attend their lectures and to criticise them. A number of other methods used in American Schools are outlined in an article by

Simpson.[84]

In a recent inquiry by Cooper and Foy[118], students and staff in a university department of pharmacy were asked to put statements describing lecturers' characteristics in order of importance. The first ten for the students, in order, were as follows: 1. presents his material clearly and logically; 2. enables the student to understand the basic principal of the subject; 3. can be clearly heard; 4. makes his material intelligibly meaningful; 5. adequately covers the ground in the lecture course; 6. maintains continuity in the course; 7. is constructive and helpful in his critisism; 8. shows an expert knowledge of his subject; 9. adopts an appropriate pace in his lectures; 10. includes in his lectures materials which are not readily accessible in text books. Staff and student ratings correlated quite highly (.77); but, whereas students valued adequate coverage of the course, attempts to link theory with laboratory and practical work, even spacing of requirements for written work, and humour, staff were much more concerned with avoidance of excess factual detail.

Audio-visual Aids

In view of the widespread use of audio-visual aids in university teaching the number of investigations to determine their value in British university Schools is rather few. It is true that some advances due to new techniques are so great that experiments are unnecessary to demonstrate them - the transmission of a lecture to millions instead of hundreds, for example, but if the value of the aid is in doubt experiments are desirable. Unfortunately, where experiments have been made their results are too little publicised so that the complaint that it takes thirty years for the findings of educational experiments to be put into practice is sometimes fully justified. In 1937, Seymour[83] showed that a light-coloured board with dark lettering was more efficient than the familiar black-board and chalk; both children and adults could read dark blue letters from a pale yellow board some 15 per cent faster than chalk letters from a black-board, while the children could copy from it in 10 per cent less time. Nevertheless, it was not until 1966 that manufacturers displayed light boards with dark 'pencils'. Even then they cannot have experimented with them in a sample of schools, for the 'pencils' contained coloured fluids and would have proved irresistible to young artists and aspiring mechanics alike. Nevertheless, these findings should be known in university departments where boards are in const use, e.g. in the mathematics departments; the use of the new boards would not only save students' time in note taking but could avoid the deposit of chalk dust commonly found on lecture-room floors.

Probably the effect of dark lines on a light background is one reason for the popularity of the overhead projector; this combines the advantages of the black-board, that the teacher can construct diagrams or notes as the lesson proceeds, with the further advantage of facing the class so that contact is not lost and adds the possibility of building up complex diagrams by use of successive, previously prepared, overlays. However, no experiments have been traced comparing these methods of presentation with each other or the overhead

projector with the black-board.

Audio tapes are comparatively cheap and, like television, have some self-evident advantages. In medicine[37] they enable students to listen to interviews between consultants and their patients which otherwise could be attended by, at most, one student; in conjunction with slides they are used to display the symptoms of diseases for the use of students overseas who lack teachers, or they may be borrowed by General Practitioners at home for revision, to acquaint themselves with new developments, or to learn to recognise symptoms of rare diseases.[38] In all of these cases the increase in efficiency is obvious; but, in university teaching, where a tape may be used to replace a lecture, experiments are necessary to determine which method is more successful.

Holloway[46] compared a formal lecture demonstration of a practical procedure in conservative dentistry with instruction by a tape recording augmented by colour transparencies, using matched groups from a class of 22 students. No significant differences were found in capacity of the groups to carry out practical work or in retention of information after one month (in so small a sample differences would need to be very great to reach significance even at the 5 per cent level); but the tape-recorder group scored significantly higher in immediate recall of information. Possibly this superiority was due to the conciseness of the tape recording which enabled students to play it twice during the time taken for demonstrations.

The use of tapes or books of information and questions, together with slides, have proved very effective in the teaching of veterinary science [109].

A chance observation of preference for a tape-recording is mentioned in the Brynmor Jones Report[97]: a professor of mathematics prepared a lecture on probability theory in such a way that the mathematics was spoken in detail as it was written on the board in order to tape it for another class; when it was repeated with the other group the lecture proved 'surprisingly successful', the students finding the absence of the lecturer advantageous to some extent.

Tape has the further advantage that it is suited to individual use. A student who finds a topic difficult can repeat it until he knows it, so avoiding constant request to his teacher for help or interruptions to a class of students who are already competent. Tapes, with slides, are being prepared for these reasons in several of London's Dental Schools. New devices which make individual operation simpler are being prepared, for example, Harden et al.[128] describe a device to record lectures synchronised with slides in an inexpensive and easily modified form.

Perhaps the most extensive development of tape in teaching is for use in language laboratories and other language teaching. Many teachers are now engaged in experiments applying the lessons and techniques of modern linguistics to the teaching of languages and to discover the best ways of using technological aids but, as yet, little of this work is even nearing completion.

McNab (Brunel University) and Locke (Ealing Technical College) are investigating how behaviourist theories of stimulus-response bonds, the concept of reinforcement and maximum motivation, together with applied linguistics and audio-visual equipment, can help to solve the problem of teaching non-language specialists to understand and speak sufficient of a language to satisfy their particular needs in the shortest possible time. McNab made a pilot experiment in the teaching of German in twenty colleges throughout the country during 1964-5 and from this developed a course which is now in preparation for publication. Like programmed learning in other fields, objectives are elaborated in a form suitable for evaluation and the course consists of carefully graded exercises requiring constant responses from the student:

> "The course is built up of the basic structures and linguistic items of modern standard spoken German. They are presented in situational context in a dialogue whose aim is to provide as naturally as possible a number of speech patterns appropriate to the situation to which the student can refer. These structures are next expanded in exercises based on a visual aid, then manipulated until overlearned in structure drills, and finally recombined and applied by the student in guided conversation. To give the student the intensive listening for comprehension practice required, every unit after Unit 3 has a listening passage associated in theme, structure patterns and vocabulary with the other material in the unit ....."

Information has been received by letter, and via a conference report, of other experiments in progress; those we mention may be taken as fairly representative of work throughout the country but it is by no means an exhaustive list. At Birkbeck College, University of London, Dr. M. Blanc reports that the Language Research Centre is engaged in research in applied linguistics and the psychology of learning languages; the research team has begun work on two projects: firstly, applying programmed learning techniques to an audio-visual Spanish course for adult beginners, research into visual perception of meaning and the place and role of the visual element in such programmed courses; and, secondly, advanced French language learning for post 'A'-level university students. This involves research in linguistics, psycho- and socio-linguistics, stylistics, testing, etc. to which other French departments are contributing, but the work is hampered by lack of recording facilities. In Birmingham University, van der Will is experimenting with tapes for class and private study as part of practical language work in German at an advanced level; at Newcastle, O'Callaghan has developed language laboratory exercises in pronunciation, grammar, comprehension and dialogue in Swedish for first-year university students; Barnett at Portsmouth College of Technology is using tapes for consecutive translation, remedial drills and for passages to be listened to and repeated while, at Cambridge, Fechner is using spaced tapes dividing the natural intonation of sentence patterns into smaller units. Information concerning other studies in progress is available from the Centre for Information on Language Teaching and many techniques are reviewed in books by Healey[42] and by Adam and Shawcross[106].

Television is the only visual aid which can form a living link between different Schools or different sections of the same School. Not only can very large audiences be reached simultaneously but experiences are accessible which could normally be observed by only one or two people at a time or in which the presence of even one observer could act as an interference. In medical schools, closed circuit television now enables large numbers of students to view an operation when it takes place or subsequently on video tape, to view a single specimen under the microscope or to observe a specialist's interview with his patient. At the Royal Free Hospital department of pathology, two such experiments have recently been made, one linking the School with the public mortuary, the other linking five Schools in different parts of the country during a pathology seminar. In the first experiment[88] a large number of students were able to view in comfort and without loss of time in travelling; gross appearances were easily seen and the pathologist's comments were very helpful although details were possibly rather difficult to appreciate and lack of colour was a disadvantage. During the second experiment[89] two cases were discussed by pathologists in the hospital School, comments and questions being invited from the other Schools. This resulted in a lively discussion of one diagnosis which had obvious value in extending the knowledge of students and, conceivably, of some members of staff.

Dr. J.L.M. Trim reports that, in Cambridge, closed-circuit television is used in language teaching to enable teachers to conduct several classes simultaneously. This is achieved by using a monitor in each of thirty booths in the language laboratory. Closed-circuit television is also used in Glasgow and elsewhere to link Colleges of Education and schools so enabling students to observe classes in action with a minimum of interference from their observation. The most extensive experimental use of closed-circuit television has been in the Nine Universities Experiment. Authors of the report[78] in 1966 comment:

> "..... the use of closed-circuit television in appropriate departments is rapidly becoming standard practice in British universities; ..... the use of lectures and demonstrations recorded by one means or another is already well-established in some of them; ..... there is a modest but increasing traffic between departments." However, they find that, "..... the idea of creating a permanent network of links for the exchange of 'live' television material between a group of universities ..... has serious administrative and financial drawbacks ..... The exchange of recorded material at present offers an altogether more flexible way of pooling resources and from the technical point of view calls only for apparatus which will be equally valuable for intra-university purposes."

Professor Cherry comments on the value of video-tape of a lecture for the purpose of revision, to clarify difficulties or to enable an absent student to catch up.

A catalogue of audio-visual activities in higher education[79] is available from the National Extension College.

Comparisons of teaching by television with traditional lectures or other conventional methods show little, if any, advantage to television. Maclaine[63] describes an experiment at the University of Sydney in which postgraduate students of education attended lectures, listened to a lecture on television, or viewed a television demonstration, but no significant differences were found in the students' ability to recall information or to indicate how to apply it. The impersonality and pace of the TV lecture were criticised, the demonstration being considered more interesting.

Macfarlane Smith, however, reports of students in 27 engineering science departments that those who included B.B.C. programmes in a course did better in an objective test of knowledge and developed a more favourable attitude to the subject than students who followed the conventional courses[138].

Experiments in English Medical Schools in teaching surgery by use of television[86, 87] showed more benefit from television, particularly to the lower 85 per cent. of students, and 29 out of 36 students who commented on the value of television as a teaching method approved it. The lecturers who use the method observe that students benefit more from TV when it is used as an ancillary visual aid, integrated into teaching, than if it is used as an unaccompanied visual aid.

Possibly the greatest contribution to efficiency in teach is that of film and film strip for they can be sent to groups who lack teachers or be used for private study. However, the number of British experiments in connection with conventional teaching in higher education is small. An extensive, carefully designed investigation into teaching in the Royal Navy was made by Vernon, comparing classes taught by conventional oral and practical instruction with other classes taught with the aid of film or film strips.[101] Seven main types of instruction were used combining the methods in different ways. Closely comparable improvements in examinations, averaging about 8 per cent, resulted from the use of the film-strip, from the addition of the film, from good versus poor instructors and from high versus low intelligence in the classes. Those improvements were highly significant statistically. The film was perhaps most successful since it took less time than the strip; when shown in conjunction with the strip it aided comprehension rather than memory for details. The film, or film strip, could largely compensate for weakness among instructors, but the taking of notes was of little value.

Kenshole[136] prepared a film loop and a tape with slides to teach 3-phase alternating current theory, in place of the usual six, one hour lectures. This did not lead to any significant improvement in attainment by first year students but resulted in a significant saving of time of 40 per cent.

Ash and Carlton[5], who studied the value of note-taking during film learning, found that it appeared to set up interference with viewing which was not wholly compensated for even when time was given to review notes

subsequently.

The efficiency of film in conjunction with other methods has also been demonstrated in the teaching of physiology.[91] Showing of the film increased knowledge of both groups of students appreciably but was most effective after prolonged preparation; however, their teachers doubted whether the additional time spent in preparation was worthwhile.

No experiments have been traced with film loops or with automatic slide projectors although some interesting pieces of apparatus and related materials have been prepared for use in teaching. Film loops lasting 2 or 3 minutes each have to be devised to illustrate a succession of concepts, so enabling students to use them in any order or to select only those of special interest to them. In the case of the slide projector accompanied by tape, or written statements of what to observe, it would be interesting to know whether questions and subsequent answers would result in better retention of material than statements. Experience in programmed learning suggests that a challenge to the student to make a response, with immediate correction of his answer, would be far more effective than the relatively passive method of telling him what to look for.

The only use of the computer we have found mentioned in British higher education is by Dr R.A. Wisbey at Cambridge for selection and grading language teaching materials. Other electronic aids are mentioned by Mr. J. Martin at at the University of Kent at Canterbury where electronic equipment is used to increase reading effectiveness in foreign languages. At the Faculty of Technology in Manchester, electronic scanning gives access to library material at a distance.

Students' Attitudes to Teaching Methods

Students' attitudes to various teaching methods have been inquired into in a number of studies. Joyce and Weatherall[54] found that a sample of their students enjoyed discussions initiated by a tape recording more than seminars conducted by teachers; they returned singly, or in small groups, to listen again to the recordings more often than students attending seminars returned for further information or discussion. However, they considered seminars more useful than discussions. Lectures were considered by all groups to be outstandingly the most useful method, and three-quarters of the students considered them most enjoyable. Reading was considered almost as useful as practicals but much less enjoyable. In this study the authors point out that an overall slight negative correlation between total estimates of usefulness and enjoyment with final marks in three sections of the test suggest that the more critical students performed better and the less critical less well. In their earlier study[53], there was negligible correlation between students' impressions of their enjoyment of a method and success in corresponding tests. They observed: "It follows that performance and students' judgments cannot both be criteria of the efficiency of teaching methods." These findings cannot be accepted as having general validity since they apply to one group of students in one medical college and a few enthusiastic teachers; but there is some

Study Skills

The term 'study skills' is used here to cover all such skills as speed and comprehension in reading, note-taking or methods of learning from notes and books; thus, they are essentially verbal skills but do not include oral skills, verbal fluency or literary style. In the university there has been a tendency to take such skills for granted; exceptional slowness in reading may be remarked on but it is not usually thought of as remediable; it is rare to find a university teacher who makes a point of exploring his students' methods of study and guiding them to use more effective techniques, yet the few investigations which have so far been made suggest that this is one area in which considerable advances could still be achieved.

Malleson et al.[144] inquired into methods of study of medical students, making them to record for each session of study a number 1 - 8 corresponding with eight different methods. They also investigated a number of attitudes and were able, tentatively, to identify certain factors in study e.g. (1) syllabus oriented: pressured v easy going, (2) methodical v enjoyable, (3) self-confident v anxious.

Comparatively recently, attention has been given to speed and comprehension in reading and to the possibility of teaching students or adults to skim in reading. Barclay used films specially prepared to increase reading speeds with sixty-one graduate students drawn from various professions, in an attempt to see whether reading speed could be increased while at least maintaining the level of comprehension.[7] All students made increases in reading speed, ranging from 7 to 213 per cent, and averaging 81 per cent. An overall improvement in comprehension was also remarked and, after lectures on methods of skimming and scanning, the group achieved a substantial cut in time taken to find facts. Although this and the succeeding experiments are encouraging, there is probably need for more extensive experiments to determine to what extent the skill is retained and whether it applies only with materials similar to those used in the initial experiment. If this proves to be so, further experiments should be undertaken using more varied materials in training the students.

Hill and Scheuer[43] used a rapid reading course for medical students, prepared by Fry,[30,31] with thirteen senior pathology students. In their case reading speed increased on the average by 110 per cent, individual improvement ranging from 36 to 241 per cent. Comprehension level was slightly raised and satisfactory speeds were reached in skimming following an exercise in the middle of the course.

A summary of many similar investigations undertaken among eight experimental populations has been made by Poulton.[75] In the sixty-six groups who took part in such experiments, mean gains in reading speed ranged from 11 to 148 per cent while those in comprehension lay between -20 and + 89 per cent. In cases where performance was re-tested some time after the experiment, individuals differed considerably in their capacity to maintain gains, some deteriorating almost to previous levels whereas others almost

In an investigation relating personality traits with attitudes to lectures, seminars and tutorials, McLeish [140] found eight roughly distinguishable types. These ranged from 'enthusiasts' who liked all methods to 'rebels' who liked none. Others markedly favoured methods in which lecturers played a major part or those which emphasised student participation. The former of these two groups appeared to be tough minded introverts with high security need, tending to be submissive and to favour formal methods and having high scholastic values. The latter valued new experience and freedom for themselves more strongly than other groups and were more anxious; ~~they were also more radical~~ in their educational views and more extraverted.

Surveys made in Australia by the Vice-Chancellors Committee [6] and of students' opinions, reported [82] in Promise and Performance show rather similar attitudes on the part of students there, although in their much wider range of abilities on entry they resemble American rather than English students.

Lecturers were criticised by many students for incoherence, dullness, poor speaking, using small, crowded or unreadable visual aids, providing too much, or too little, detail and being above the students' level; whereas about two-thirds of them found tutorials (small group discussions) helpful, almost a quarter disliked them. But since the students themselves propose that they should be divided into 'better' and 'weaker' groups for discussion it may be that the range of ability makes it difficult to satisfy the needs of students at the extremes of ability. The authors concluded (as British Medical students also found): "tutorials, to judge from what was reported to us, are at their most successful when they are closely related to previously considered material - whether it is a course of lectures, or recommended reading, or previously prepared questions." Their medical, dental and engineering students were strongly in favour of 'case-study' tutorials.

A point on which opinions differ between Australian students and their teachers and to a greater extent between the teachers themselves is in the provision of duplicated notes. Eighty-three per cent of students like them [6] because they find them more accurate than their own notes, closer to the course and useful in revision. Eight per cent of the students, however, disapprove of them, saying that they make students lazy. The teachers are divided, some regarding notes as spoon feeding, an encouragement to 'swotting' from notes only and to passivity on the part of the student; these point out the strain on secretarial resources and consequent tendency to use the same notes from year to year. But no-one, it seems, objects to laboratory notes, field notes or instructions for experimental work or to bibliographies and essay or reading lists. Those who favour use of duplicated notes consider that they save time for the lecturer, allow him to digress profitably without leading his students to lose sight of the central argument, compensate for lack of suitable books or for library deficiencies and may incorporate journal material that is not easily accessible. The inquiry however shows that the kind of notes provided differs widely - from brief outlines provided in advance, or occasional summaries, to verbatim reports of most lectures or very full notes comprising hundreds of pages which serve as the department's 'text-book'. It is the latter which is more generally disapproved.

In Britain teachers of all universities think that students should make their own notes though a summary acting as a 'framework' may be found beneficial and some teachers of sciences find it necessary to supply notes where books are lacking or out of date.[96] Students who contributed to Marris' inquiry were of the opinion that too much time was spent in taking notes. Some felt that the taking of notes began the process of memorising or understanding information, but that this advantage was gained at too great a cost. They considered that duplicated notes for discussion in class would probably be better.

It is of interest that there is so much to report as to students and teachers' attitudes but so few objective inquiries into the effects of duplicated notes. Since disagreement is widespread, this would appear to be one area in which extensive experiments could provide information in the place of what may well be prejudiced observation or opinions.

SKILLS AND ABILITIES

A wide variety of skills and abilities are required in learning at the university level, ranging from mechanical and manual skills, in which one procedure must be learned and repeated accurately, to higher mental abilities, such as skill in solving unfamiliar problems, where flexibility in thinking and capacity to consider unexpected possibilities play a considerable part in success. Different methods of learning and teaching are required in these cases but an essential in learning all skills is that the student should have adequate opportunity for practice and should receive information as to his success.

Mechanical and Manual Skills

Learning of mechanical and manual skills has not been studied experimentally among university students although there a number of interesting innovations in teaching.

In industry, however, fairly extensive studies have been made in the teaching and learning of skills. Many of these are described by Seymour [154]. Some of the findings have relevance to practical skills learned in certain university courses such as the filling of a tooth, dissection of a cadaver or assembly of electrical circuits from diagrams. Seymour distinguishes the 'knowledge' and 'skills' content in learning a practical task. The former involves memory for symbolic material in the form of words, numbers of diagrams, which is said to be learned when it has been memorized and can be recalled appropriately; the skills content involves non-symbolic information and its acquisition requires motor and perceptual learning. If the knowledge content can be readily memorized, the control of the motor activities can proceed unimpeded. Difficulty arises when diagrams and written texts have to be consulted as the task proceeds or where the level of discrimination required is

near the threshold for that particular sense. This difficulty is overcome in learning skills, such as dissections, where instructions are played on audio-tape which the student can stop at will. Alternatively, a tape dealing with the entire process, emphasising difficult points, seems highly effective. In a personal communication, Dr. Goodhue of the Biology Department at Trinity College, Dublin reports that tapes, together with diagrams and other illustrations he has prepared, have proved so successful in teaching 1st year students to dissect rats that their initia' attempt which formerly took 3 hours, with many errors (after a demonstration) are now completed almost perfectly in one hour.

Experiments suggest that it is wasteful to practice too intensively initially. Henshaw et al.[131] did an experiment with three groups of 30 subjects employed on chain assembly for eighty minutes each morning. In the afternoon, Group I did another 80 minutes chain assembly, Group II practised a different operation and Group III did no assembly, yet the performance of the three groups remained almost identical, but it is a common experience that rest periods improve performance - in learning to drive a car, for instance, or in learning to swim. Seymour suggests that the optimum period of practice initially is half an hour, extending to two hours when the individual is already practised.

An observation in many of the more complex skills is that the learner reaches plateaux, where he appears to make little or no progress, but that these are followed by rapid improvements, possibly owing to the synthesis of a number of skills. Whether the skill transfers to another task seems to follow from the extent to which it depends on selecting similar groupings of activities of the muscles, and the skill the individual shows in 'selectivity' i.e. in more frequent selection of optimum responses.

Contradictory results have been obtained in studies of learning by part or whole methods. Woodworth [154] favoured the 'whole' method with special attention to and repetition of difficult or important parts. This may account for Goodhue's success since his method consists in showing the whole dissection, but with coloured diagrams for critical stages. Experiments at Birmingham University Department of Engineering Production([154], Ch 8) suggests that a more useful distinction is between perceptual content of different parts of the task than between 'part' and 'whole'. Results of one experiment suggest that elements of a task with difficult perceptual content require longer training and that, therefore, methods which enable greater attention to be concentrated on these are advantageous. Of interest here is a finding that in learning to type, students who began to learn on an electric typewriter later attained greater speeds on a manual typewriter than those who learned to use the manual typewriter first. Thus initial 'pacing' by the machine had a lasting effect [125].

As in other fields, knowledge of results leads to more rapid learning; what is needed is an exact and prompt indication of what went wrong and the direction from 'wrong' to 'right'.

Study Skills

The term 'study skills' is used here to cover all such skills as speed and comprehension in reading, note-taking or methods of learning from notes and books; thus, they are essentially verbal skills but do not include oral skills, verbal fluency or literary style. In the university there has been a tendency to take such skills for granted; exceptional slowness in reading may be remarked on but it is not usually thought of as remediable; it is rare to find a university teacher who makes a point of exploring his students' methods of study and guiding them to use more effective techniques, yet the few investigations which have so far been made suggest that this is one area in which considerable advances could still be achieved.

Malleson et al.[144] inquired into methods of study of medical students, making them to record for each session of study a number 1 - 8 corresponding with eight different methods. They also investigated a number of attitudes and were able, tentatively, to identify certain factors in study e.g. (1) syllabus oriented: pressured v easy going, (2) methodical v enjoyable, (3) self-confident v anxious.

Comparatively recently, attention has been given to speed and comprehension in reading and to the possibility of teaching students or adults to skim in reading. Barclay used films specially prepared to increase reading speeds with sixty-one graduate students drawn from various professions, in an attempt to see whether reading speed could be increased while at least maintaining the level of comprehension.[7] All students made increases in reading speed, ranging from 7 to 213 per cent, and averaging 81 per cent. An overall improvement in comprehension was also remarked and, after lectures on methods of skimming and scanning, the group achieved a substantial cut in time taken to find facts. Although this and the succeeding experiments are encouraging, there is probably need for more extensive experiments to determine to what extent the skill is retained and whether it applies only with materials similar to those used in the initial experiment. If this proves to be so, further experiments should be undertaken using more varied materials in training the students.

Hill and Scheuer[43] used a rapid reading course for medical students, prepared by Fry,[30,31] with thirteen senior pathology students. In their case reading speed increased on the average by 110 per cent, individual improvement ranging from 36 to 241 per cent. Comprehension level was slightly raised and satisfactory speeds were reached in skimming following an exercise in the middle of the course.

A summary of many similar investigations undertaken among eight experimental populations has been made by Poulton.[75] In the sixty-six groups who took part in such experiments, mean gains in reading speed ranged from 11 to 148 per cent while those in comprehension lay between -20 and + 89 per cent. In cases where performance was re-tested some time after the experiment, individuals differed considerably in their capacity to maintain gains, some deteriorating almost to previous levels whereas others almost

entirely maintained their new high levels.

An investigation of greater interest, because it should lead to greater understanding of how students study and so lead to better means of guiding them, is that of Jahoda and Thomas.[50] They are in the process of finding out in what ways students and lecturers set about extracting information from books and lectures and how they define the learning task to themselves. In a pilot survey, 20 individuals were asked to study each of three passages - an introduction to cybernetics presenting a rigorously logical argument; a history text requiring memory for relatively unfamiliar names and a text on clinical psychology in common sense terms - until they felt they had learned it; they were then asked to compose questions which would adequately test whether a person had learned the passage and were themselves asked questions designed to test what they had learned and at what level of abstraction. During the course of study their progress from page to page was recorded. It proved that techniques differed widely: rapid scanning followed by study of selected passages, perhaps repeatedly, a careful first reading checking back only on a few important passages, constant referral to earlier paragraphs, and so on. Some used identical strategies on each passage whereas others generated strategies appropriate to the material. Questions set by members of the experimental sample in some cases dealt wholly with details while others concentrated on principles. As a result of this pilot study alone, the authors consider that staff time spent early in a course on individual tutoring, encouraging students to examine their learning processes, could save time later and increase the students' range.

Freyberg has experimented with several methods of note-taking[29] but these were imposed by the experimenter. He used four methods with parallel groups of students: taking no notes, writing full notes, making an outline or accepting a duplicated summary. His findings suggest that these methods are effective for different purposes: where material was to be recalled very soon but was not required for examinations, taking no notes proved most successful; if it was to be examined, learning from duplicated notes gave the best results. However, the experiment is a limited one. Further experiments would be required to show how these different methods influenced students' learning and study skills over a longer period, and prior discussion with some students of how to take notes more effectively might substantially influence results if the experiment was repeated.

Hartley and Cameron[129] investigated note taking by recording the number of items in a lecture and checking how many of these were mentioned by students in notes. Rather less than one third of what was said was transmitted to note books but this included about half of what the lecturer considered important. References, definitions, names and words written on the blackboard were recorded but experiments leading to theory were omitted. The method suggested that the students regarded the lecture as a framework of ideas and theory in which to fit subsequent work; all reported that they would do subsequent work but only 3 of 22 students did any. The authors conclude that a weakness of the lecture system as a teaching method lies in the discrepancy between the students' stated and achieved objectives; they suggest that the lecturer

should reconsider his own objectives, possible ways of attaining them and techniques to measure their achievement.

Essay writing and the writing of laboratory reports are other skills which tend to be taken for granted by university teachers. One lecturer in London University mentioned recently how poor the essays were in the final examination of his department but, in reply to a question, he admitted that the students were not required to write a single essay during their three-year course! Evidently their teachers were making two assumptions, both of which we would consider unjustified: firstly, that students would have the skill to write essays despite lack of practice and, secondly, that answers in essay form were appropriate to test understanding or skill, in a subject which did not require verbal work of this kind while learning it. But this may be a common error: Beard, Levy and Maddox noted a high correlation between scores in a verbal test and an Engineering Drawing examination and commented that the examination was probably unnecessarily verbal in content[9].

Where written reports are required there is evidence that students can be helped to improve them considerably in the course of learning. Dr. A.P. Prosser (Imperial College, University of London) sets experimental problems to pairs of first-year engineering students who must solve the problem and discuss their solutions in some detail with the tutor before writing their reports.[77] He comments that the reports are technically of higher quality and more comprehensive since the introduction of this method, and that marked improvement can be observed during the year in describing and interpreting results. Although it is fairly generally agreed that putting one's ideas on paper is an aid to clarity in thinking, the ways in which it does so have not been investigated. It is almost certainly partly because inter-relationships too complex to hold in mind can be seen more readily when spelled out or arranged diagrammatically, but no doubt the effort to find the right word to express a half-framed idea, in itself, leads to greater clarity. Since it is one of the most important skills it deserves investigation, both as to how different individuals set about it and how teachers can aid students in improving their techniques.

Oral Skills and Group Discussions

Oral skills have always been important in the medical and dental professions for the doctor or dentist must communicate with his colleagues or with his patients; in the legal profession also, oral skills have always been an essential requirement to elicit information or to exercise persuasion. But, mainly since the war, proliferation of committees has increased the need for oral skills among engineers and scientists, while the use of television and other audio-visual aids has increased the use of oral communication and at the same time made audiences more critical. Consequently, not only must the student develop a capacity to present a report, or to engage in a discussion with experts in other fields but, as in all communication, he must appreciate factors which influence decisions, such as interaction between members of a committee, their difficulties with subject matter, any prejudices they are likely to show, and so on. So, for effective presentation of his case, the young scientist like the doctor or lawyer must learn to express himself well and should gain at

least practical experience, if not theoretical knowledge, of group dynamics.

During the last few years, partly owing to the influence of the Hale Report, the use of group discussion methods has considerably increased in university teaching. Their chief purpose differs from subject to subject; thus, in biology, probably their most important purpose is encouragement of critical thinking, in mathematics, discussion of students' difficulties and, in engineering, younger students discuss problems primarily mathematical in nature whereas older ones are more likely to consider applications of engineering to industry.[10] But in most subjects at some time, there are occasions when a student gives a talk on a prepared topic and leads the subsequent discussion. In this way students may learn to play different roles within a group.

That even limited group discussion can have an influence on subsequent oral work was shown by Erskine and Tomkin.[27] After only two periods of discussion during a three-week course on anatomy, their students did appreciably better in oral examinations than those who attended nine lectures.

Studies of group discussion have been made almost exclusively in the United States. But, in England, Abercrombie and Klein[57,58] have made substantial contributions. There is general agreement that some of the important variables are seating position, talkativeness, personality of the participants and the kind of leadership. Position proves to be more important than casual observation suggests: the leader's position if he sits separate from the group but facing them, indicates that he expects members of the group to address him but not each other; if he sits at the head of a table this suggests that he expects to be addressed a substantial part of the time; he must sit among the group as a member of it, or outside it as an observer, if he wishes the group members usually to address each other. Individuals within the group tend to choose positions according to whether they wish to talk or not, preferring a place opposite the leader if they wish to talk to him, but adjacent to him otherwise; a member opposed to the group may withdraw his chair from the circle. Generally, members tend to address those who face them more than members placed adjacent to them. A teacher may use this to encourage a quiet member to talk by placing him opposite a talkative one, or quieten the talkative by placing them next to each other or to the leader. Persistently silent members must be assigned an active part by preparing a paper, or a few points to begin the discussion, while the over-talkative can be silenced by inviting him to be group secretary or by thanking him for his contribution and inviting other comments on the points he has raised.

Klein[58] observed that in a series of free discussions members tended to establish characteristic interaction frequencies, high interactive sub-groups, particularly pairs, being formed. In line with American findings she found that the more voluble members tended to be popular and that agreement on the ranks of members increased as the series proceeded. American studies have shown also that it is the talkative members who can most readily get the support of the group. A normally silent member given the best solution of a problem fails to get it accepted without the aid of one of the most voluble participants. Tuckman and Lorge also found[95] that contributions by members of low status were

normally ignored in arriving at a group solution to a problem; in such a case the solution arrived at by putting together the best points from all individual solutions excelled the solution of the same individuals when working in a group.

Deutsch studied the effect of giving different information to group members as to the assessment of group work.[20] Some groups were told that they would be assessed collectively, in co-operation, while others were informed that each individual would be assessed independently, in competition with other members of the group. The 'co-operative' group showed more co-ordination of effort, diversity in amount of contribution, sub-division of activity, attentiveness to fellow members, mutual comprehension and communication, greater orientation and orderliness and productivity per unit time, as well as favourable evaluation of the group and its products. Berkowitz et al. found[12] that, in groups of three students who were evaluated favourably or unfavourably for contribution made, those groups in which all members were unfavourably rated were most integrated and most highly motivated, while those in which members received different ratings found each other less attractive and were least motivated. Thus, in both cases, an element of competition and perceived differences in achievement were destructive of a group spirit and achievement within the group. Personality may also have a similar effect; Haythorn et al. found[41] that students of a markedly authoritarian personality were more aggressive and less effective in group discussion than those who were rated 'egalitarian' on the California F-scale.

Contributions of a discussion leader as compared with an observer have been studied by Maier & Solem.[68] They found that minorities obtained a better hearing in a group having a leader and tended to be sheltered by the leader, so that minorities with strongly expressed, but wrong, views continued to hold them in groups with a leader, but were forced to change their views and to accept a correct solution in leaderless groups. This suggests that free group discussion with an observer may be more effective in encouraging critical thinking than discussion in a group with a teacher; but the scope of the experiment is inadequate for anything more than a suggestion that this may be worth investigating further.

The value of discussion between students in the absence of a lecturer does not appear to be recognised generally in university courses. Students consulted by Marris[70] said that they frequently discussed their work with each other and could be less inhibited with staff absent; it was a more satisfactory way of dealing with difficulties since they felt that seeking help from staff was viewed as a confession of incompetence. Teachers who have organised work so that students discussed questions together in pairs, or small groups, before raising further questions with them have found the method very successful.[10]

Higher Mental Skills

Critical thinking

'Critical thinking', 'scientific thinking' or 'understanding' are terms which come readily to the minds of teachers when they are asked to outline their chief aims in teaching. However, it is commonly added that many students are very limited in their capacity to think critically. Medical students are often mentioned as a group "less able than most Honours students" who, due to poor ability, are dependent on their teachers, unable to learn without considerable guidance and who, moreover, must be enabled to recall a mass of information before it is possible for them to begin to discuss intelligently or to deal with problems. Teachers who argue in this way would do well to study the findings of psychologists who have investigated the factors operating in transfer of training.

Thorndike[94] in the earlier phases of these investigations concluded that only identical elements of content, or pattern of procedure, could be transferred from one learning situation to another. In the case of medical courses, for example, some procedures in pre-clinical subjects are relevant in related post-clinical work and to this extent habits of work transfer directly and beneficially. But transfer applies equally to undesirable habits: learning by rote without understanding, accepting rather than challenging authoritarian statements, and concentrating on accumulation of facts rather than interpreting them or making decisions, are also likely to be transferred to the post-clinical course if they have been the pattern of behaviour in the pre-clinical school. Since recent work suggests that more generalised training may be transferred when there is similarity between the new situation and the one in which the behaviour was learned, it seems imperative to provide a situation in which students are encouraged to be critical as soon as possible. Thus teachers who insist that medical knowledge can be introduced by means of problems which require initiative and understanding in the students as they solve them are more likely to train doctors of a critical habit of mind with capacity to educate themselves.

Psychologists would also expect students, like children, to succeed best where teaching methods arouse most interest and most activity on the part of the learner. With children evidence already exists that retention of information is at least as good when it is gained as a by-product of solving problems as when inculcated by efficient teaching of information only. No doubt this is partly because the information becomes organised into a meaningful whole which, as we have seen, aids retention. Further, the method is likely to inspire so much interest that the children spontaneously follow up the problems, thus extending their range of learning. However, we cannot say categorically that teaching students through problems is more efficient than other current methods, in terms of inculcation of information, for no experiment has been carried out at their level comparing this method with others.

That there is an essential difficulty in thinking objectively, owing to unconscious assumptions and habits built up in the course of learning, has been shown by Abercrombie and others; reception of information, recollections, observations and description, judgements or inferences are alike affected. These assumptions operate even with relatively simple material in visual illusions, in giving verbal definitions or in understanding the meaning of a word, as well as in tasks for which more training is needed such as interpreting X-rays. Teachers have various methods of combating this problem but it is questionable whether they are fully aware of its extent. They recognise that for the student to be led to new skills for which his existing habits and skills are inadequate they must organise new material in a way which is meaningful to him. But if the step is too great for him, or a problem too difficult, they tend to repeat their first explanation or to show again the steps of a solution to the problem without examining the student's assumptions and preconceptions. To do so involves either prior study of all possible wrong assumptions, with questions or procedures to correct them (as provided in some branching programmed texts) or discussion.

Johnson-Abercrombie experimented with undirected group discussions. Her aim was to avoid instruction in a 'correct' method but to develop a scientific method by stimulating students to work out problems among themselves by mutual questioning and correction. For example, in an early study with James and Venning, one group of students was trained to be observant in studying X-rays and other visual material by criticism of their own descriptions and inferences, so becoming aware of assumptions and preconceptions which influenced the receipt of visual information.[51] It should be noted that the experimenter did not play the part of a director of discussion but was an onlooker who asked a question or commented somewhat in the manner of a psychiatrist in a group therapy session. The responses of the participants are also reminiscent of volunteers or patients in group therapy. Some inquired the purpose of it all and asserted that they had gained nothing from such undirected work (rejecting the experience), while others developed feelings of insecurity or hostility which they worked through; and nearly all were astonished, or even dismayed, on discovering how greatly unconscious assumptions had influenced their judgements. In subsequent comparison of this group with one conventionally taught, in observation of three X-rays, the trained group were superior to a highly significant degree: they made fewer false inferences, fewer inferences unaccompanied by descriptions, more of them considered two hypotheses rather than one only and a smaller number were inappropriately biased by one test in dealing with the succeeding one. Evidently a change in behaviour did occur due to this kind of general discussion. Barnett[8] used group discussion in a similar fashion with eight students using alternate two-hour meetings, in a series of 24, for free discussion following the reading of a brief, and sometimes controversial, passage or article; like Abercrombie, he observed the discussions without intervening until the end. He found that students came gradually to stick more to the point and to criticise each other's arguments more effectively - there was rather less arbitrary statement of personal prejudices and rather more attempt at rational argument, but these trends were only beginning to appear towards the end of twelve periods of discussion. Behaviour of some members of the group was noticeably influenced, e.g. in talking more, or less, or in becoming

A new line of inquiry into students' and lecturers' abilities and personalities promises to cast more light on creativity in different fields. Hudson[48] has distinguished what he terms 'convergent' from 'divergent' thinkers: the former excel in intelligence tests but tend to avoid ambiguity and prefer tests with a single right answer; the latter are comparatively poor in standard tests of intelligence but show great fluency in producing ideas. For example, when asked to think of uses for a brick or a paper clip, the converger mentions one or two uses for each, whereas the diverger produces a large number. 'Divergence' and reasoning, as required in intelligence tests, appear to be fairly unrelated. In addition to individuals biased in either direction, there are 'high all-rounders' who score above the median in both and 'low all-rounders' who score below it in both.[52] Those with a bias tend to specialise in different fields - the able convergent thinker chooses physical sciences, the outstanding diverger prefers the arts or administration.

The qualities Hudson finds characteristic of original thinkers of either kind are dedication to work, self-confidence, gressiveness, a desire to go down in history and a taste for taking risks Creative workers describe themselves as: inventive, determined, independent, individualistic, enthusiastic and industrious; whereas the non-creative select such adjectives as: responsible, sincere, reliable, dependable, clear thinking, tolerant and understanding

TEACHING FOR CHANGE OF ATTITUDES

Attitudes and Higher Abilities

In discussion of methods of developing critical thinking we have seen that group discussions exposed prejudices and misconceptions so changing attitudes as well as capacity to think objectively. It is probable that certain attitudes preclude critical thinking or originality, whereas others promote them; the student who clings inflexibly to what he learned at an earlier stage, whether consciously or not, must remain uncritical and any attitude which prevents him from experimenting, such as fear of being proved wrong or looking foolish, is likely to diminish his capacity for finding original solutions or making inventions. To be original it is essential to have an attitude favourable to novelty and exploration Most probably the development of all higher mental skills is bound up with the concomitant development of favourable attitudes. but there is too little evidence to show this conclusively.

We may reasonably expect increasing attempts to foster understanding of environmental influence on patients and clients in subjects such as medicine, dentistry and law. Some medical schools have already set up departments of social medicine or epidemiology; Davies[120] suggests that student dentists should 'study the patient and the economic. social and political

Gane, Horablin and Lewis[34] have begun work on clarifying decision-making in industry and in government directives to the public, but they have also suggested application in other topics including the making of diagnoses in medicine. They give an example for the diagnosis of Raynand's Disease and Secondary Raynand's Phenomenon, too complex to reproduce here; but a simpler example (sketched on the following page) suffices to demonstrate the method although it does not require the cross linking and diversity of possible solutions of the medical diagnosis chart.

By this technique, everything which must be taken into account is itemised. Different methods of presenting the data can avoid production of excessively large charts, either by listing instructions or by presenting a number of sub-charts. The use of charts of these kinds in industry has resulted in dramatic improvements in training time and in general efficiency. Their value in university teaching has not yet been explored, but the authors suggest that medical diagnosis charts may be used to update experienced practitioners with new developments or as useful memory 'joggers'. They have an obvious value to the advanced student in giving him, almost at one glance, all the factors which need to be taken into account in coming to a decision. The authors comment that the same advantages would hold if the chart dealt with completely different kinds of subject matter such as, say, technological information or the laws relating to taxation. Almost certainly somewhat similar charts would guide students in the solution of familiar kinds of mathematical problems.

Designers of programmed books have analysed subject matter and strategies in solving problems to present them in such a way that specific methods of problem-solving are learned and more general problem solving techniques are derived. One essential factor in successful solution appears to be recall, or reminder, of relevant principles. Where a reminder is needed it has been found more effective not to state the required principles but to ask questions which result in the student recalling or rediscovering them.

A technique increasingly used in America and beginning to be used in Britain is the 'simulation technique'. Tests or 'games' are used to simulate situations in which it would be unsafe or impracticable for students to take charge in reality, such as diagnosing and treating diseases, deciding on land uses, replanning a town, and so on[156,157]. In this way the medical student, for example, can decide on tests and treatments, selecting as many as he wishes from a list provided, following through the consequences of his decisions in subsequent sections of a booklet until his 'patient' recovers or succumbs. This may be a useful supplement to observations on the wards: some students who have used the method commented that they realised for the first time the consequences of the decisions they would be called on to make[137].

Solving unfamiliar problems, creative thinking

Ability to solve unfamiliar problems is becoming increasingly important in scientific work, but there has been practically no systematic study of this skill. A recent study by Connor of students' problem-solving identified several stages in solving moderately familiar problems; but the students proved

SELECTION, EVALUATION AND TEACHING METHODS

Selection and Teaching

The usual response of teachers to failure by large numbers of students in examinations is to criticise the examination itself or to demand that selection of students should be improved. It is rare that modification of teaching methods is advocated, or even considered, although evidence exists that these, and the curriculum, may equally be causes of failure. Beard et al., for example, studied [9] the results of students in two departments of engineering in Birmingham, correlating results in departmental examinations with scores in tests of general reasoning and verbal, numerical and perceptual abilities, as well as inquiring into study habits, social participations of the students and the course content. Correlations between test scores of intellectual abilities and marks in the first-year examinations were preponderantly negative in one department. Consideration of factors likely to result in negative correlations suggested that the most probable cause was insufficient demands on abler students during their first year. Other data from the investigation showed that in this department there was more repetition of school work in the first year, less initial guidance, less pressure to work and less work set, less personal contact between staff and students and more self-education than in the other; there was also a slower pace of work and more students took up distracting activities unrelated to their course of study. Thus, in this instance, the test data indicated ways in which the course could be evaluated and modified.

A different recommendation for improving attainment by students arose from an inquiry to determine predictives of failure by Nisbet and Welsh. [71] Study of first-year performance, in particular, at this Scottish university showed that those in the bottom third of the class in two or more subjects in examinations at the end of the first term were most likely to fail in finals. But it proved that the rate of failure could be reduced by an early warning system following this examination, for feed-back as to the probability of failure resulted in greater effort and success. The authors point out that the system is, of course, more effective when work in the first term is similar to that in the second and third years.

When subjects differ essentially in content in different years of the course prediction of success from year to year is much less certain. Furneaux correlated examinations results for students at the end of their first and second years of a course. [32] On the whole correlations were poor and attainments in first-year Applied Electricity, for example, correlated more highly with second year mathematics (0.69) than did first-year mathematics (0.47). Thus the practice of insisting that a student should pass in first-year work before proceeding to the second in this subject seemed unjustified. In addition, students' examination results were influenced by personality characteristics, introverts with neurotic tendencies doing significantly better than stable extroverts. But this, too, may be due to curricula and to methods of teaching and learning normally employed in the university. Furneaux comments "....it became clear

very poor at unfamiliar tasks and it was rare for them to check on adequacy or appropriateness of their conclusions[117]. There seems to be a fairly prevalent belief that inventive and creative workers are born, not made, despite evidence that some university departments and certain teachers have produced an unexpectedly high number of creative workers. There is evidence too that the greater proportions of distinguished scientific workers in America came from the Eastern coast initially but subsequently have been produced by Schools further and further west. These findings at least suggest that creative talent is a product of inborn ability with favourable early experience maybe, but also inspired teaching or example at university level. Since good success in first-degree courses does not necessarily indicate capacity for original work nor a poor degree prove inability to think creatively, there is some evidence that existing first-degree examinations and courses fail to give sufficient opportunity to students to solve unfamiliar problems or to show origniality. Hudson[48] observed that in Cambridge there was no relation between degree class and subsequent academic honours: fully a third of the future FRS's at Cambridge had gained a second or worse at some time during their university careers and the proportion among future DSc's was over a half. There is, in consequence, a move in some departments to take account of dissertations or other original course work.

Although ability to think creatively in the sciences is of increasing importance, no British investigation into teaching methods to encourage it has been traced. Nevertheless, some innovations have been made in teaching. In both pure and applied sciences 'open-ended' experiments are being introduced; these allow a student to draw his own conclusions or may require him to find an answer to a problem by experiments of his own devising; but there is still no experimental work to show whether the method is effective. There is, however, a little evidence which suggests, as we might expect, that opportunity to work creatively results in a greater output of creative work. Hayes[40] investigated the effect of student dissertations as part of a graduate requirement in a medical school; during the three years of the experiment student participation in research increased: in 1961, 25 per cent, in 1962, 26.5 per cent and, in 1963, 45.5 per cent of papers in the students' journal were based on original work. A number of schools are now introducing research projects. Jones[135] reports carefully chosen projects in organic chemistry undertaken by third year students. The subject is chosen at the end of the Autumn term. Practical work is undertaken the following Spring and the paper produced at the end of the term contributes to the students final assessment. Students work jointly on a project or two or three students work on a related project. The 'experiment' is so successful that it is to become the standard 3rd and 4th year course in practical organic chemistry.

There are similar encouraging reports of research projects in a clinical medical course in London[23, 165]. While in engineering Allen reports that projects which require students to solve unfamiliar industrial problems arouse considerable interest and enthusiasm as well as promoting skill and ability in solving unfamiliar problems and creative thinking[160].

A new line of inquiry into students' and lecturers' abilities and personalities promises to cast more light on creativity in different fields. Hudson[48] has distinguished what he terms 'convergent' from 'divergent' thinkers: the former excel in intelligence tests but tend to avoid ambiguity and prefer tests with a single right answer; the latter are comparatively poor in standard tests of intelligence but show great fluency in producing ideas. For example, when asked to think of uses for a brick or a paper clip, the converger mentions one or two uses for each, whereas the diverger produces a large number. 'Divergence' and reasoning, as required in intelligence tests, appear to be fairly unrelated. In addition to individuals biased in either direction, there are 'high all-rounders' who score above the median in both and 'low all-rounders' who score below it in both.[52] Those with a bias tend to specialise in different fields - the able convergent thinker chooses physical sciences, the outstanding diverger prefers the arts or administration.

The qualities Hudson finds characteristic of original thinkers of either kind are dedication to work, self-confidence, gressiveness, a desire to go down in history and a taste for taking risks Creative workers describe themselves as: inventive, determined, independent, individualistic, enthusiastic and industrious; whereas the non-creative select such adjectives as: responsible, sincere, reliable, dependable, clear thinking, tolerant and understanding

TEACHING FOR CHANGE OF ATTITUDES

Attitudes and Higher Abilities

In discussion of methods of developing critical thinking we have seen that group discussions exposed prejudices and misconceptions so changing attitudes as well as capacity to think objectively. It is probable that certain attitudes preclude critical thinking or originality, whereas others promote them; the student who clings inflexibly to what he learned at an earlier stage, whether consciously or not, must remain uncritical and any attitude which prevents him from experimenting, such as fear of being proved wrong or looking foolish, is likely to diminish his capacity for finding original solutions or making inventions. To be original it is essential to have an attitude favourable to novelty and exploration Most probably the development of all higher mental skills is bound up with the concomitant development of favourable attitudes. but there is too little evidence to show this conclusively.

We may reasonably expect increasing attempts to foster understanding of environmental influence on patients and clients in subjects such as medicine, dentistry and law. Some medical schools have already set up departments of social medicine or epidemiology: Davies [120] suggests that student dentists should 'study the patient and the economic. social and political

characteristics of the environment in which he lives' and points out that ' in many ways the success of a dentist depends as much on understanding his patients as persons as upon his technical knowledge and facility'. Students of law also have begun to study sociology.

Such evidence as there is points to free group discussion as a more potent method for changing attitudes than lectures or seminars conducted by tutors. A number of research workers have remarked on changes in attitude occurring in group members. Barnett[8], for example, refers not only to increase in critical thinking but also to an influence on the behaviour of some members in becoming less aggressive. Hallworth[39] used interpretation of group reactions to make members of a group of teachers more aware of processes influencing them, such as aggressive feelings to authority, and so enabled them to become more self-critical and to develop skills concerned with group management.

From reports by individual teachers it is evident that 'games' involving role playing also influence attitudes by increasing insight into other people's problems. In one College of Art students playing the role of administrative staff developed sympathy towards an unpopular member of staff or realizing that he was at the end of a communication line, he received many complaints but had no-one to consult or to pass them to. Similar 'games' have been found helpful with managers in industry, while Ashley [110] reports role-playing recorded on video tape as an aid to social workers in understanding group interactions and thus to handling human relationships in general.

However, it is possible to use methods which influence attitudes without fostering criticism or insight. In an experiment by King and Irving[56], students were asked to read a passage, either silently or aloud, advocating extension of the period of military service or, alternatively, to prepare a talk based on the arguments in the passage. Although oral reading gave students the greatest satisfaction, as indicated by their self-ratings, it was the improvised talks which resulted in the speakers accepting the message in the persuasive communication significantly more often than those who merely read it. This seems to be a further example of more efficient 'learning' due to active involvement on the part of the learner. Nevertheless, few teachers would approve this as a method of 'teaching' unless it was used to make students aware that they could be so influenced. The result of this experiment suggests also that choice of textbooks and written exercises, and the unconscious biases of tutors in work they set, may have a more potent influence on students' attitudes than might have been supposed.

An aspect of influence on attitudes that has not been investigated in British universities is imitation of teachers or identification with them by students. There seems to be no doubt that this happens to some extent and it may be partly inability to learn in this way which accounts for antipathy to large classes or complaints by students of lack of contact with staff. Abercrombie[2] quotes experiments showing the importance of perceived proximity of children to parent figures or teachers and the need for a feeling that authorities are approachable among adults. She comments: "This feeling

of easy access is very important in all sorts of teaching situations, and we can encourage the accessibility or discourage it with minor adjustments of the environment". However, until investigations are made there are no findings to pass on to teachers who find this difficult to do intuitively.

Motivation

An important objective of teachers is to increase the interest, or motivation, of the majority of students. We have already mentioned some of the factors which contribute to promote them: clear definition of goals with intermediate and immediate objectives, prompt feed-back as to success, active, rather than passive, methods of learning and variety in teaching methods. In addition, open-ended problems, dissertations or 'research' projects can arouse considerable enthusiasm. Collier[15] organised courses in educational sociology by setting joint assignments based on reading, discussion and writing to syndicates of five or six adult students, the class meeting daily for periods of eighty minutes throughout six weeks. Students reported greater intellectual stimulation and that they read more and looked more critically at the task than they would have done with traditional lectures and set work. A majority gained more satisfaction from working in groups and reported a sense of obligation to their groups to do well. Edwards mentions[23] an experiment at St. Mary's Hospital Medical School in setting clinical students projects within the field of pathology or clinical medicine which has resulted in some outstanding work, showing the benefit of giving a sense of autonomy and responsibility to the students. The engineers are also reporting in meetings that there are interesting programmes in use allowing more autonomy to students but none of these is yet in print.

An experiment which suggests new possibilities of increasing the motivation of students by personality matched courses has been made recently by Joyce and Hudson[52], but is not yet published. It suggests that teachers and students resembling each other with respect to being 'convergent' or 'divergent' types form the most successful combinations in teaching.

Perhaps this has some bearing on a peripheral finding in a study by Lewis and Pask of communication by mechanical means without verbal interchange.[61] They reported that persons with high IQ were rather bad at communicating, partly because they overrated the receivers' abilities but also because they were more vulnerable to the introduction of misinformation. This looks like the intolerance of convergers to ambiguity. It may be that, in teaching, convergers tend to give a lucid and logically presented account of subject matter, which is acceptable to student convergers, whereas divergent teachers favour digression which sparks off ideas in other divergers but frustrates the convergers' need for good organisation. In some cases, however the relationship is more complex and teachers consistently gain a similar degree of success with the same sub-categories of students from one year to another.

SELECTION, EVALUATION AND TEACHING METHODS

Selection and Teaching

The usual response of teachers to failure by large numbers of students in examinations is to criticise the examination itself or to demand that selection of students should be improved. It is rare that modification of teaching methods is advocated, or even considered, although evidence exists that these, and the curriculum, may equally be causes of failure. Beard et al., for example, studied [9] the results of students in two departments of engineering in Birmingham, correlating results in departmental examinations with scores in tests of general reasoning and verbal, numerical and perceptual abilities, as well as inquiring into study habits, social participations of the students and the course content. Correlations between test scores of intellectual abilities and marks in the first-year examinations were preponderantly negative in one department. Consideration of factors likely to result in negative correlations suggested that the most probable cause was insufficient demands on abler students during their first year. Other data from the investigation showed that in this department there was more repetition of school work in the first year, less initial guidance, less pressure to work and less work set, less personal contact between staff and students and more self-education than in the other; there was also a slower pace of work and more students took up distracting activities unrelated to their course of study. Thus, in this instance, the test data indicated ways in which the course could be evaluated and modified.

A different recommendation for improving attainment by students arose from an inquiry to determine predictives of failure by Nisbet and Welsh. [71] Study of first-year performance, in particular, at this Scottish university showed that those in the bottom third of the class in two or more subjects in examinations at the end of the first term were most likely to fail in finals. But it proved that the rate of failure could be reduced by an early warning system following this examination, for feed-back as to the probability of failure resulted in greater effort and success. The authors point out that the system is, of course, more effective when work in the first term is similar to that in the second and third years.

When subjects differ essentially in content in different years of the course prediction of success from year to year is much less certain. Furneaux correlated examinations results for students at the end of their first and second years of a course. [32] On the whole correlations were poor and attainments in first-year Applied Electricity, for example, correlated more highly with second year mathematics (0.69) than did first-year mathematics (0.47). Thus the practice of insisting that a student should pass in first-year work before proceeding to the second in this subject seemed unjustified. In addition, students' examination results were influenced by personality characteristics, introverts with neurotic tendencies doing significantly better than stable extroverts. But this, too, may be due to curricula and to methods of teaching and learning normally employed in the university. Furneaux comments "....it became clear

that the problem which confronts us is really that of understanding the way in which the characteristics of the student and of the university interact to determine particular outcomes."

That A-level results are a poor indication of success in degree courses in sciences is shown by the findings of Bagg [111], Richards and Wilson [151] and Elton [122]. Bagg found that for a small sample three A-level science results correlated negatively with marks in a technology; while, for chemical engineers, the summed total of A-level results was a somewhat better predictor than the result in chemistry or any other subject. Richards and Wilson reported that the failure rate of students entering physics courses with the highest A-level results was asgreat as 15%, and, in a survey of physics departments, Elton finds little predictive value in A-level results except that those with high grades are more likely to get some kind of degree than those with low grades. However, of nine students entering with E grades, five received honours degrees. Elton's main finding is that University departments with identical entrance standards, 42, 38 and 72 per cent of students gained honours degrees. He concludes that "the attainment of a student at a University may depend almost as much on the idiosyncrasy of the university as on the ability of the student", and points to evidence of different standards in teaching in departments of London University which take the same examinations.

Evidently, in addition to those factors normally considered in selection problems - such as students' abilities and interests, their previous experience and the nature of the entrance examination - reduction in failures can also result from changes in teaching, modifications in the course, improved staff-student relations or more information to the student as to the success of his learning.

Evaluation and Teaching

As teaching methods have been considered increasingly in relation to stated objectives so methods of evaluation have been reconsidered and supplemented. In the past the only universal evaluation technique was the terminal, or final, examination which was used to rank students and to determine whether they had attained an 'agreed standard'. Numerous inquiries during the last thirty years or so have shown how ineffectively traditional exams, employing essay questions, oral and practical tests, achieved these objectives. There is a demand today for more varied types of assessment to meet the variety of aims in teaching as well as for more evaluation of learning and teaching during courses. Black reports of an inquiry into University examinations in physics [112]: "In general, departments replied that they had not formulated rules about the style of questions, did not analyse systematically the abilities tested by the questions, did not ask for model answers and did not ask for a marking scheme". There were no multiple choice examinations, the questions being of the bookwork-essay type or in two parts - bookwork followed by a problem. All the questions were of the same style, different papers testing different topics but not different types of ability

A different pattern of examining in physics is reported by Elton [121].

In his department the final assessment is based on (1) examinations at the end of the sixth and the beginning of the ninth terms, which each carry about a third of the marks and (2) course work assessments, under 5 headings: (a) an essay written in the first summer vacation (b) an open-book oral examination at the end of the fifth term (c) full reports on three experiments selected by the examiners from those in the laboratory during the second year (d) an oral examination on two other experiments, 30 minutes notice being given as to which ones, and (e) a project which is undertaken during the whole of the final term. Account is also taken of the level of the courses chosen during the first two years. Elton comments that although the reliability of marks for course work is low, the validity is high.

In medicine multiple choice tests are in fairly common use in terminal assessments and in some final examinations [11]. Anderson [108] advocates in-course testing to motivate students to achieve their maximum performance. He points out the need to devise tests of clinical skills and habits that the student has acquired in relation to history taking, clinical examination of the patient, bedside tests, etc. and suggests the use of microphones to aid assessment of the students' abilities in taking histories. The Todd Report [153] also recommends the use of continuous assessment in clinical courses.

A different approach to the study of evaluation is to consider students' attitudes, personality traits and objectives. Walton and Drewery [161] found that of those who did badly in an objective test in psychiatry the majority were highly extraverted; they were not good at medical examinations in general, not so good clinically, were prone to express value judgments to patients and to give advice, and were inclined at the beginning of the course to consider psychiatry irrelevant to their future professional work. Low scorers expressed disappointment with the amount and quality of teaching about drugs and physical treatments whereas high scorers wished for more teaching in psychology and sociology.

Malleson [143] also found that, in the case of clinical students, high drive introverts did best and low drive extroverts were the least successful, whereas in the 2nd M.B. there was no difference between these groups. He suggested that the 2nd M.B. course was so highly structured and controlled that there was little latitude for the individual's personality to influence his attainment.

Assessment of course work has not yet been studied in any detail. Commonly used methods such as exercises, essays, problems, etc. which are marked some time after the student completes the work are being increasingly criticised because they often fail to detect causes of students' difficulties, tend to be marked uninformatively and provide corrections, if any, too late to influence learning at the critical time. Three new types of evaluation are being developed to give more objective and immediate assessment both to teacher and student.

Evaluation of current teaching

The first attempt to evaluate university teaching concentrated on qualities of the teacher. Possibly this was inspired by a desire to reward the best teachers in university departments even if they were not outstanding research workers for it is generally believed that it is excellence in research alone which gains advancement. Rating scales were devised in America and were later modified for use abroad. In Queensland[81], for example, students were invited to express their reactions to their teachers' performances with a view to obtaining a group opinion from a set list of characteristics of teachers. A teacher meeting with the students' approval might find that, in his case, students had underlined such statements as: "knows subject thoroughly; interested in teaching; never stops learning; always well prepared; presents material in systematic fashion; uses varied methods; sets high standards; .....; has a sense of humour." Whereas for his less fortunate colleague they might endorse: "Often does not know subject; is unsystematic, vague and rambling; has no clear standards; shows undesirable personal qualities such as laziness, impatience, prejudice, intolerance; has annoying mannerisms; will not admit errors; .....". But attempts to achieve group views in this way, which really had a bearing on teaching, were unsuccessful. Teachers perform differently when they teach different topics, or classes of different abilities, or when they employ different teaching methods; they may even perform well in one university department and indifferently in another. Students, or colleagues, also differ in the way they assess teaching; some praise highly a conscientious teacher who covers the syllabus thoroughly in well organised lectures while others look for inspiration and originality, preferring to obtain basic information in private study.

In more recent studies of teaching, therefore, it is the teaching itself which is assessed, either by testing how much information students have gained or by inquiring early in a course whether the teaching could be adjusted in any way to meet students' needs more fully. In some departments frequent testing is used for the information of staff and students. In the department of Mechanical Engineering, University of Birmingham, weekly quizzes (brief written tests) are used in this way, a generally poor result being accepted as a reflection on teaching in that topic.[9]

Inquiries into the effectiveness of a teacher's communication with his class cover a wider range of information: students may be asked to endorse one of five statements about the amount of material during a period of teaching: "far too much, ..., satisfactory, ... practically nothing worth saying," or of speed "spoken too fast, ..., about right, ... tediously slow," etc., as well as making comments on conditions in the room, use of audio-visual aids, value and quality of applications or examples, adequacy of answers to questions, and so on.[11,67] In this way, even if the replies are somewhat damaging to the teacher's self-esteem, he has a guide to future action which should enable him to communicate better with that group of students.

Evaluation of on-going learning

The psychologists' findings that correct responses in learning should be speedily reinforced, or wrong ones as speedily corrected, does not meet with ready acceptance among all university teachers. There seems to be a prevalent feeling that students are mature enough to wait for their corrections; but, although they may be expected to wait with patience, the evidence is that, in any learning, prompt feed-back leads to greater efficiency. This is, of course, one of the advantages of programmed learning.

Various methods have been devised, or arrived at intuitively, which do provide feed-back to every student on his recall and understanding of informational material, or test his grasp of principles and how to apply them, and all have been found extremely effective.[11] Such methods normally include (i) questions for students to answer (e.g. short answer items, multiple-choice questions, short problems or brief essay questions), (ii) immediate provision of correct answers or discussion by students of their answers and opportunity to look up further information, putting any outstanding questions to the tutor, (iii) correction of the students' records for use in revision. The tutor may also set practical work depending on the information gained, or recommend further related study. These methods have the double merit that the students can assess their own learning and retain corrected records, while the tutor obtains feed-back on the effectiveness of his teaching from the students' failures, questions, or enthusiasm for further inquiry.

Assessment of courses

We observed earlier that no studies of courses in British universities had so far been published. However, studies of entire courses are now in progress in seven universities in England and, although they are necessarily longitudinal, some results may soon be available. Otherwise, attempts to evaluate courses are limited to inquiries into 'consumer satisfaction'. In this respect, medical schools in London have made considerable progress for the majority of teachers replying to a questionnaire reported that they 'always' (25 per cent) 'frequently' (25 per cent) or 'sometimes' (27 per cent) invited criticisms or suggestions from their students about courses or teaching.[11] Teachers in three of the dental schools probably corresponded more nearly with the majority of university teachers, the corresponding percentages being approximately: 20, 16, and 28.

In a post-graduate school where every item of a teaching programme was graded on a 3 point scale, a fall was reported in the number of dissatisfied course members, staff were stimulated by knowing that they were assessed and students co-operated more willingly [126].

However, the difficulty of satisfying all the students in a course of lectures is stressed by Falk [124] who recorded comments by four students on the same series of lectures in history:-

(1) Made a fascinating period of history very flat.

(2) Congratulations on an exceedingly workmanlike job of teaching as opposed to purely lecturing.

(3) Gives students impression that they are back in the school-room. By this I mean over-simplification, over-clarification.

(4) These lectures were the best I've had this year.

It is true that the range of ability among first year students in Australia is very wide, but even in England the opinions of teaching capacity of lecturers tends to vary from student to student and as classes change from year to year.

COURSES AND SERVICES FOR UNIVERSITY TEACHERS

During the past few years short courses have been provided for new and experienced teachers in Universities. In Australia, Rayner[148] describes courses of a kind now fairly familiar in England, in which staff hear lectures on University policy, teaching methods etc., attend classes on voice production and public speaking, and discuss the aims of University teaching, methods of examining and assessment of students' work, the functions of different teaching methods and University discipline. Such courses normally occupy several consecutive days or evenings of one term. In Queensland the sessions valued most are those on university facilities such as closed-circuit television and teaching aids, practice sessions on seminar leadership and discussion of examination techniques. In London, where rather similar courses are run for new lecturers, sessions most appreciated are those in which the participants are themselves active[150]; there has been a demand particularly from younger lecturers, to keep lectures short and to maximise time for discussion.

McKevitt[139] reports an experiment at Stanford University in which teachers are recorded on videotape and view their performances later, either in company or alone. They are instructed to look for such points as (1) skill in pre-instructional procedures e.g. establishment of rapport, provoking interest and giving cues as to what will follow. . . . (4) skill in pacing e.g. pauses and moments of silence, time to ask questions, to facilitate transition from one point to another and in introduction of a new idea, etc. This method stimulates self-improvement, facilitates guidance and makes possible a study of variables involved in teaching.

At Melbourne, courses for teachers and studies of teaching are provided jointly by the University Teaching Project Office and the Education Research Office[123]. The former has developed a variety of services to Faculties, Departments and individual members of staff: these comprise

(1) empirical studies of existing teaching and learning practices which are undertaken at the request of the departments concerned; (2) considerations with the staff, of the theory by which such practices can be evaluated; (3) courses of training, largely based on the findings of (1) and (2); (4) a consultant service for members of staff whose needs are not met by the courses. This service includes visits to classes, discussions and help as required e.g. with speech therapy, construction of course notes and other techniques of teaching; (5) cooperation with Departments in the planning of new courses and in the use of new aids and techniques: (6) basic research, when pressure for services permits this. Investigations under heading (1) normally involve a full report from staff and students as to the efficacy of teaching methods, techniques of evaluation, etc. but the findings are confidential until such time as a large body of comparative data is available.

Some of the new universities have planned services to teachers from their inception. At Sussex, lecturers in Education may also teach in other University departments; this has the dual advantage of ensuring that staff in the Education department have equal status with those in other departments and that specialists are more likely to hear about new teaching methods. At Essex, in each large department, it is proposed that a member of staff should specialise in teaching methods, providing courses and information for his colleagues. An increasing number of University schools now appoint a Research Officer to study teaching or invite visiting experts to develop new teaching techniques. Alternatively, University Institutes of Education are invited to make investigations. At London, some colleges have asked for studies of their course to be undertaken, chiefly where objectives need analysing or where new techniques of evaluation are required. Many teachers in higher education themselves are showing considerable interest in developing teaching methods or in conducting teaching experiments; they welcome the aid of psychologists and specialists in education but maintain the initiative in their schools. Thus, at London, they give enthusiastic support to conferences on special topics e.g. a recent conference on 'Innovations and Experiments in University Teaching Methods' [160] and subsequently organise groups with similar interests to develop objective tests, the use and construction of programmed books, etc.

In view of criticisms at the level of secondary education where research into teaching methods and the training of teachers are conducted largely independently of teachers in the schools, the determination of University teachers to play an active role in investigating teaching methods seems highly desirable. For otherwise there is a danger that new ideas will be developed in the colleges of education, or in psychology departments but will not be adequately communicated or accepted by the teachers. For example, an inquiry by Maddox [142] showed that one teacher training course suffered a number of deficiencies: 'few students had an opportunity to observe a range of teachers, many had no close or detailed supervision, the general academic instruction which preceded the practice period in teaching, even if cognitively accepted, seldom influenced class-room practice. Innovations, therefore, tended not to be effectively communicated to student teachers, many of whom continued to use methods they were familiar with as pupils'. Raitt [147] who studied teacher training of graduate chemists found that most

departments of education had inadequate laboratory facilities and that five-sixths of the departments gave less than the sixty-three hours teaching in chemistry which was the estimated bare minimum to meet the needs which teachers in training expressed. He lists the chief requirements in training which were mentioned by young teachers and adds that, on the whole, the teachers felt that they had not been adequately helped in these respects. This kind of situation would be unlikely to arise if there was close cooperation between teachers and each department of education or if some teachers served as part-time tutors in the departments.

If training is to be introduced for University teachers there are, therefore, several obvious recommendations; firstly, objectives in teacher training should be very fully considered; secondly, University teachers (especially those beginning to teach) should be consulted as to their needs, and reports by students on teaching methods should be studied; thirdly, university teachers should share in the responsibility for any courses that are planned and should play an active part in them; fourthly, they should increasingly introduce innovations or undertake experiments in teaching methods, possibly being allowed free time to do so. In this way, the role of psychologists and specialists in education will be that of consultants only and a high level of interest in teaching methods is likely to be maintained, or developed, in university departments.

CONCLUSIONS

Inquiry or research into teaching in higher education is rapidly gaining momentum. Of the references cited here six date from before 1950, sixteen were published between 1950 and 1959 and the remaining one hundred and forty four appeared from 1960 to 1968; hundreds more investigations or experiments are in preparation. Interest in teaching methods at this level has grown considerably, most notably in the medical schools, technical colleges and language departments; many courses and conferences on teaching are held and are well attended, while four new journals devoted to education in biology, chemistry and, more recently, physics and medicine point to a new, or increasing, concern with the effectiveness of teaching methods. Many more teachers are now taking part in inquiries or experiments. From the foregoing survey, it is evident that there is much for them to do. Only very limited conclusions can be drawn from the studies so far completed, yet changing subject matter and curricula, increasing numbers of students and the introduction of further new techniques in teaching continue to give rise to fresh problems.

In areas where experiments or inquiries have been most numerous, developments are likely to follow fairly rapidly. Increased efficiency in teaching may be expected in the near future partly through linking Schools and

departments by closed circuit television so that lectures and demonstrations can reach a wider audience, and partly by the use of other new techniques in class teaching or for individual study, such as programmed learning, audio- or video- tape and slides or film-loops with tapes.

However, where experimental work has been less adequate, carefully planned sequences of experiments or inquiries are still needed. It is not usually possible to draw general conclusions from comparison of one teaching method with another on one occasion in a single department. What is needed is a concerted effort in studying each method, collating information already available, and experimenting with variations of the method to see which ones are most effective and under what circumstances. Since, for various reasons, small group discussions are used increasingly this is one area in which well-designed experiments in a cross section of Schools would be particularly rewarding. Other investigations which are likely to prove most rewarding are those into higher mental abilities and students' methods of studying. Such knowledge will enable teachers to gain more insight into students' difficulties and to devise more flexible methods of teaching which take account of their differences.

Increasing acceptance of the desirability of evaluating courses, teaching and learning should lead to a more precise formulation of objectives, for realistic evaluation is impossible unless objectives are clearly defined. Perhaps also some teachers and students need to change their attitudes to routine evaluation, accepting it as necessary feed-back to ensure the efficient operation of the learning process rather than as damaging criticism of personal competence.

Research into teaching methods in higher education is now expanding rapidly. It remains for teachers and psychologists to ensure that the most pressing and fundamental problems are investigated and on a sufficiently large scale to have general application. In this way we may hope to build up a theory of teaching and learning which will enable us to solve new problems as they arise and to design courses which will achieve our objectives with certainty.

REFERENCES

1. ABERCROMBIE, M.L.J. (1965) The Anatomy of Judgment. Hutchinson: London.

2. ABERCROMBIE, M.L.J. (1966) "Perception and communication" in Teaching Methods in University Departments of Science and Medicine, report of a conference held at the University of London Institute of Education, January 1966. (out of print)

3. ADAMS, B.G., DANIEL, E.E., HERXHEIMER, A. and WEATHERALL, M. (1960) "The value of emphasis in eliminating errors", British Medical Journal, 1960 (2), 1007-1011.

4. ANDERSON, D.S. (1964) "The person and environment in first year medicine" in Melbourne Studies in Education 1961-62 (ed. FRENCH, E.L.), 91-113. Cambridge University Press: London.

5. ASH, P. and CARLTON, B.J. (1953) "The value of note-taking during film learning", British Journal of Educational Psychology, 23, 121-125.

6. AUSTRALIAN VICE-CHANCELLORS COMMITTEE (1963) Teaching Methods in Australian Universities. (Chairman: PASSMORE, J.A.)

7. BARCLAY, T.B. (1957) "Effective reading", University of Edinburgh Gazette, 17, 22-30.

8. BARNETT, S.A. (1958) "An experiment with free discussion groups", Universities Quarterly, 12, 175-180.

9. BEARD, R.M., LEVY, P.M. and MADDOX, H. (1964) "Academic performance at university", Educational Review, 16(3), 163-174.

10. BEARD, R.M. (1967) An Inquiry into Small Group Discussion Methods in Three Disciplines. University Teaching Methods Research Unit, University of London Institute of Education.

11. BEARD, R.M. (1967) "On evaluating the success of teaching", British Journal of Medical Education, 1(4), 296-302.

12. BERKOWITZ, L., LEVY, B.I. and HARVEY, A.R. (1957) "Effects of performance evaluations on group integration and motivation", Human Relations, 10, 195-208.

13. BLACK, P.J., DYSON, N.A. and O'CONNOR, D.A. (1968) "Group Studies" - to be published. Physics Education, Vol. 3, No. 6.

14. BRITISH MEDICAL STUDENTS' ASSOCIATION (1965) Report on Medical Education: Suggestions for the Future. BMA: London.

15. COLLIER, K.G. (1966) "An experiment in university teaching", Universities Quarterly, 20 (3), 336-348.

16. COMMITTEE ON HIGHER EDUCATION (1963) Higher Education. HMSO: London.

17. COTTRELL, T.L. (1962) "Effect of size of tutorial group on teaching efficiency", University of Edinburgh Gazette, 33, 20-21.

100. UNWIN, D. (1966) "An 'organisational' explanation for certain retention and correlation factors in a comparison between two teaching methods", Programmed Learning, 3, 1.

101. VERNON, P.E. (1946) "An experiment on the value of the film and film-strip in the instruction of adults", British Journal of Educational Psychology, 16, 149-162.

102. WALLIS, D., DUNCAN, K.D. and KNIGHT, M.A.G. (1966) "The Halton experiment" and "The Melksham experiment" in Programmed Instruction in the British Armed Forces. HMSO : London.

103. WALTON, H.J. and DREWERY, J. (1964) "Teaching psychiatry to undergraduate medical students", Journal of Medical Education, 29(6), 545-552.

104. WALTON, H.J. and DREWERY, J. (1966) "Psychiatrists as teachers in medical schools", British Journal of Psychiatry, 112, 839-846.

105. WILSON, J.F. (1966) "A survey of legal education in the UK", The Journal of the Society of Public Teachers of Law, 9(1), 1-144.

ADDITIONAL REFERENCES

106. ADAM, J.B. and SHAWCROSS, A.J. (1963) Language Laboratory, Pitmans.

107. ANDERSON, J., BUKITT, D., GEAL, M.A. and COCKER, P. (1968) "How clinical students spend their time", British Journal of Medical Education, 2 (1) 4-10.

108. ANDERSON, J. (1967) "Testing clinical competence", British Journal of Medical Education, 1 (5) 345-347.

109. APPLEBY, E.C. and POLAND, J. (1968) "Some observations on the use of tape-recorded programmes in teaching veterinary pathology" in Innovations and Experiments in University Teaching Methods (see 160)

110. ASHLEY, B. (1968) "Group dynamics in human relations training", Case Conference, 15 (2).

111. BAGG, D.A. (1968) "The correlation of GCE A-level grades with university examinations in chemical engineering", British Journal of Educational Psychology, 38(2), 194-197.

112. BLACK, P.J. (1968) "University examinations", Physics Education, 3(2), 93-99.

113. BLAUG, M. (1968) Universities and Productivity. Universities Conference, March 1968.

114. BROADBENT, G. (1968) "A plain man's guide to systematic design methods", RIBA Journal, May 1968, 223-227.

115. BURGE, R.E. (1968) "Wider London B.Sc.", Times Educational Supplement, 1st March 1968.

35. GAUVAIN, S., WOOD, C.H., WALFORD, J. and SCHILLING, R.S.F. (1967) "Experiment in postgraduate education to evaluate teaching and examining techniques", Journal of Medical Education, 40(1), 516-523.

36. GLYNN, E. (1965) "Keys to chemistry (a personal effort in programming)", New Education, I, 21-22.

37. GRAVES, J. and GRAVES, V. (eds.) (1963) Report on conference on the use of tape in medical teaching at College of General Practitioners. Medical Recording Service and Sound Library, Royal College of General Practitioners.

38. GRAVES, J. and GRAVES, V. (1965) Medical Sound Recording. Focal Press: London and New York.

39. HALLWORTH, H.J. (1957) "Group discussion in its relevance to teacher training", Educational Review, 10, 41-53.

40. HAYES, D.M. (1964) "Objective evaluation of a subjective teaching method: the student dissertation", Journal of Medical Education, 39, 1083-1089.

41. HAYTHORN, W., COUCH, A., HAEFNER, D., LANGHAM, P. and LANNOR, F.C. (1956) "The behaviour of authoritarian and egalitarian personalities in groups", Human Relations, 9, 57-74.

42. HEALEY, F.G. (1967) Foreign Language Teaching in Universities. Manchester University Press.

43. HILL, K.R. and SCHEUER, P.J. (1965) "A rapid reading course", Royal Free Hospital Journal, 29, 23-25.

44. HOARE, D.E. and INGLIS, G.R. (1965) "Programmed learning in chemistry II : an experiment", Education in Chemistry, 2(1), 32-35.

45. HOLLAND, W.W., GARRAD, J., BENNETT, A.E. and RHODES, P. (1966) "A clinical approach to the teaching of social medicine : an evaluation of an experimental method", Lancet, 1966(1), 540-542.

46. HOLLOWAY, P.J. (1964) "A test of the use of a teaching aid for the instruction of undergraduate dental students in operative techniques", The Dental Practitioner, 14, 375-377.

47. HOLLOWAY, P.J. (1966) "The effect of lecture time on learning", British Journal of Educational Psychology. 31 (3), 255-258

48. HUDSON, L. (1966) Contrary Imaginations : A Psychological Study of the English Schoolboy. Methuen: London.

49. INHELDER, B. and PIAGET, J. (1958) The Growth of Logical Thinking. Routledge & Kegan Paul: London.

50. JAHODA, M. and THOMAS, L.F. (1966) "The mechanics of learning", New Scientist, 30, 114-117.

51. JAMES, D.W., JOHNSON, M.L. and VENNING, P. (1956) "Testing for learnt skill in observation and evaluation of evidence", Lancet, 1956(2), 379-383.

52. JOYCE, C.R.B. and HUDSON, L. (1968) "Student style and teacher style". British Journal of Medical Education, 2(1), 28-31.

53. JOYCE, C.R.B. and WEATHERALL, M. (1957) "Controlled experiments in teaching", Lancet, 1957(2), 402-407.

54. JOYCE, C.R.B. and WEATHERALL, M. (1959) "Effective use of teaching time", Lancet, 1959(1), 568-571.

55. KENDALL, M. (1964) A Bibliography of Research into Higher Education. Research Unit for Student Problems: University of London.

56. KING, B.T. and IRVING, J.L. (1956) "Comparison of the effectiveness of improvised versus non-improvised role-playing in producing opinion changes", Human Relations, 9, 177-186.

57. KLEIN, J. (1961) Working with Groups. Hutchinson: London.

58. KLEIN, J. (1965) The Study of Groups. Routledge & Kegan Paul: London.

59. LEITH, G.O.M. and BUCKLE, G.F. (1966) Mode of Response and Non-Specific Background Knowledge. National Centre for Research and Documentation of Programmed Learning: University of Birmingham.

60. LEITH, G.O.M. and McHUGH, G.A.R. (1967) "The place of theory in learning consecutive conceptual tasks", Educational Review, 19(2), 110-117.

61. LEWIS, B.N. and PASK, G. (1964) "The development of communication skills under adaptively controlled conditions", Programmed Learning, 1, 69-88.

62. MacLAINE, A.G. (1963) "An experiment with closed-circuit television at the University of Sydney", Australian Journal of Education, 7(3), 157-164.

63. MacLAINE, A.G. (1965) "A programme for improving teaching and learning in Australian Universities", The Australian University, 3, 3.

64. McLEISH, J. (1966) "Student retention of lecture material. A methodological study", Cambridge Institute of Education Bulletin, 3(3), 2-11.

65. McCLINTOCK, C.G. and TURNER, H.A. (1962) "The impact of college upon political knowledge, participation and values", Human Relations, 15(2), 163-176.

66. McKEACHIE, W.J. (1966) "Research in teaching: the gap between theory and practice" in Improving College Teaching. American Council on Education.

67. McVEY, P.J. (1967) "Evaluation of four lectures by means of questionnaire", University of Surrey, Department of Electrical and Control Engineering, Report No. TR3.

68. MAIER, N.R.F. and SOLEM, A.R. (1952) "The contribution of a discussion leader to the quality of group thinking", Human Relations, 5(3), 277-288.

69. MANN, P.H. and MILLS, G. (1961) "A study of universities. Section III. Living and learning at Redbrick - I. Academic conditions", Universities Quarterly, 16, 19-24.

70. MARRIS, P. (1965) The Experience of Higher Education. Routledge & Kegan Paul: London.

71. NISBET, J. and WELSH, J. (1966) "Predicting student performance", Universities Quarterly, 20(4), 468-480.

72. OWEN, S.G., HALL, R., ANDERSON, J. and SMART, G.A. (1965) "A comparison of programmed learning instruction and lectures in the teaching of electrocardiography", Programmed Learning, 2, 2-14.

73. PIAGET, J. (1926) Language and Thought of the Child. Routledge & Kegan Paul: London.

74. POPPLETON, P.K. and AUSTWICK, K. (1964) "A comparison of programmed learning and note taking at two age levels", British Journal of Educational Psychology, 34(1), 43-50.

75. POULTON, E.C. (1961) "British courses for adults on effective reading", British Journal of Educational Psychology, 31(part II), 128-137.

76. POWELL, J.P. (1966) Universities and University Education : A Select Bibliography. NFER, Slough.

77. PROSSER, A.P. (1967) "Oral reports on laboratory work" in Teaching for Efficient Learning, report of a conference held at the University of London Institute of Education, January 1967. UTMRU: University of London Institute of Education.

78. RESEARCH UNIT OF THE NATIONAL EXTENSION COLLEGE (1966) University Intercommunication : The Nine Universities Research Project. Pergamon Press: Oxford.

79. RESEARCH UNIT OF THE NATIONAL EXTENSION COLLEGE (1966) A Survey of Audio-visual Activities in Universities and Colleges of Advanced Technology. National Extension College: Cambridge.

80. SCHONELL, F.J. et al. (1961) "Australian University Experiment : Problem and promise", Australian Journal of Science, 24 (1), 19-20.

81. SCHONELL, F.J. et al. (1961) University Teaching in Queensland : A Report of Conferences for Demonstrators and Lecturers.

82. SCHONELL, F.J., ROE, E. and MEDDLETON, I.G. (1962) Promise and Performance. University of Queensland Press, 340 pp.

83. SEYMOUR, W.D. (1937) "An experiment showing the superiority of a light coloured 'blackboard'", British Journal of Educational Psychology, 7, 259-268.

84. SIMPSON, R.H. (1965) "The use of self-evaluation procedures by lecturers in educational psychology", Educational Review, 18 (1), 25-33.

85. SLAVINA, L.S. (1957) "Specific features of the intellectual work of unsuccessful pupils" in SIMON, B. (ed.) Psychology in the Soviet Union. Stanford University Press.

86. SMITH, G. and WYLLIE, J.H. (1965) "Use of closed-circuit television in teaching surgery to medical students", British Medical Journal, 1965(2), 99-101.

87. SMITH, G., WYLLIE, J.H., FORTE, A.V. and CARADIS, D.T. (1966) "Further studies of the use of closed-circuit television in teaching surgery to undergraduate students", British Journal of Medical Education, 1, 40-42.

88. SPECIAL CORRESPONDENT (1966) "Necropsy demonstrations relayed by television", British Medical Journal, 1966 (1), 478.

89. SPECIAL CORRESPONDENT (1966) "Closed-circuit television between medical schools", British Medical Journal, 1966 (1), 1476-1477.

90. STAVERT, G.S. and WINGATE, T.H. (1966) "Nelson's Navy needed none but ...! TutorAge, 17, 2-7.

91. STEINBERG, H. and LEWIS, H.E. (1951) "An experiment on the teaching value of a scientific film", British Medical Journal, 1951(2), 465-471.

92. STONES, E. (1966) "The effects of different conditions of working on student performance and attitudes", Programmed Learning, 3(3), 135-145.

93. STUDENTS' SOCIETY COMMITTEE OF ROYAL DENTAL HOSPITAL SCHOOL OF DENTAL SURGERY (1966) "Report on opinion poll on the lecture 'courses'", Supplement to Extract, 33, Part I.

94. THORNDIKE, E.L. (1913) The Psychology of Learning. Teachers College, Columbia University.

95. TUCKMAN, J. and LORGE, I. (1962) "Individual ability as a determinant of group superiority", Human Relations, 15(1), 45-57.

96. UNIVERSITY GRANTS COMMITTEE (1964) Report of the Committee on University Teaching Methods (Chairman: HALE, Sir E.). HMSO: London.

97. UNIVERSITY GRANTS COMMITTEE, DEPARTMENT OF EDUCATION AND SCIENCE and SCOTTISH EDUCATION DEPARTMENT (1965) Report of the Committee on Audio-Visual Aids in Higher Scientific Education (Chairman: JONES, Brynmor). HMSO: London.

98. UNIVERSITY TEACHING METHODS RESEARCH UNIT, University of London Institute of Education (1966) Teaching Methods in University Departments of Science and Medicine : Report of the first conference organised by the Unit, January 1966. (out of print)

99. UNIVERSITY TEACHING METHODS RESEARCH UNIT, University of London Institute of Education (1967) Teaching for Efficient Learning : Report of the second conference organised by the Unit, January 1967.

100. UNWIN, D. (1966) "An 'organisational' explanation for certain retention and correlation factors in a comparison between two teaching methods", Programmed Learning, 3, 1.

101. VERNON, P.E. (1946) "An experiment on the value of the film and film-strip in the instruction of adults", British Journal of Educational Psychology, 16, 149-162.

102. WALLIS, D., DUNCAN, K.D. and KNIGHT, M.A.G. (1966) "The Halton experiment" and "The Melksham experiment" in Programmed Instruction in the British Armed Forces. HMSO : London.

103. WALTON, H.J. and DREWERY, J. (1964) "Teaching psychiatry to undergraduate medical students", Journal of Medical Education, 29(6), 545-552.

104. WALTON, H.J. and DREWERY, J. (1966) "Psychiatrists as teachers in medical schools", British Journal of Psychiatry, 112, 839-846.

105. WILSON, J.F. (1966) "A survey of legal education in the UK", The Journal of the Society of Public Teachers of Law, 9(1), 1-144.

ADDITIONAL REFERENCES

106. ADAM, J.B. and SHAWCROSS, A.J. (1963) Language Laboratory, Pitmans.

107. ANDERSON, J., BUKITT, D., GEAL, M.A. and COCKER, P. (1968) "How clinical students spend their time", British Journal of Medical Education, 2 (1) 4-10.

108. ANDERSON, J. (1967) "Testing clinical competence", British Journal of Medical Education, 1 (5) 345-347.

109. APPLEBY, E.C. and POLAND, J. (1968) "Some observations on the use of tape-recorded programmes in teaching veterinary pathology" in Innovations and Experiments in University Teaching Methods (see 160)

110. ASHLEY, B. (1968) "Group dynamics in human relations training", Case Conference, 15 (2).

111. BAGG, D.A. (1968) "The correlation of GCE A-level grades with university examinations in chemical engineering", British Journal of Educational Psychology, 38(2), 194-197.

112. BLACK, P.J. (1968) "University examinations", Physics Education, 3(2), 93-99.

113. BLAUG, M. (1968) Universities and Productivity. Universities Conference, March 1968.

114. BROADBENT, G. (1968) "A plain man's guide to systematic design methods", RIBA Journal, May 1968, 223-227.

115. BURGE, R.E. (1968) "Wider London B.Sc.", Times Educational Supplement, 1st March 1968.

116. BURKE, W.H. (1967) "The new course and its development", Design Education 2, 19-24. Hornsey College of Art.

117. CONNOR, D.V. (1967) "A study of problem solving in physics", Australian Journal of Higher Education, 3(1), 55-67.

118. COOPER, B. and FOY, J.M. (1967) "Evaluating the effectiveness of lectures", Universities Quarterly, 21(2), 182-185.

119. DARKE, M. (1968) "Teaching design methods", RIBA Journal, January 1968, 29-30.

120. DAVIES, G.N. (1967) "Changing concepts in dental education", New Zealand Dental Journal, 63, 107-112.

121. ELTON, L.R.B. (1968) "The assessment of students - a new approach", Universities Quarterly, 22(3), 291-301.

122. ELTON, L.R.B. (1968) "Success and failure in university physics courses" (in press).

123. FALK, B. (1966) "The preparation and in-service training of university staff", Australian Journal of Higher Education, 2(3), 200-206.

124. FALK, B. (1967) "The use of student evaluation", The Australian University, 5(2), 109-121.

125. GARBUTT, D. (1963) "An investigation into students' understanding of some accountancy terms", The Vocational Aspect of Secondary and Further Education, 31(15), 69-169.

126. GAUVAIN, S. (1968) "The use of student opinion in the quality control of teaching", British Journal of Medical Education, 2(1), 55-62.

127. GUILD, R.E. (1966) "An experiment in modified programmed self-instruction", Journal of Dental Education, 30, 181-189.

128. HARDEN, R.McG., WAYNE, Sir E. and DONALD, G. (1968) "An audio-visual technique for medical teaching", Journal of Medical and Biological Illustration, 18(1), 29-32.

129. HARTLEY, J. and CAMERON, A. (1967) "Some observations on the efficiency of lecturing", Educational Review, 20(1), 30-37.

130. HEALEY, F. (1967) Foreign Language Teaching in the Universities. Manchester University Press.

131. HENSHAW, E.M., LANGDON, J. and HOLMAN, P. (1933) Manual Dexterity : Effects of Training. IHRB Report 67. HMSO : London.

132. HOLLOWAY, P.J., HARDWICK, J.L., MORRIS, J. and START, K.B. (1967) "The validity of essay and viva-voce examining techniques", British Dental Journal, 123 (5), 227-232.

133. INSTITUTE OF PHYSICS and the PHYSICAL SOCIETY (1960) The Post-graduate Training of Physicists in British Universities. Institute of Physics.

134. JENKINS, M.I., SAUNDERS, E.H. and MACFARLANE SMITH, I. (1968) "An experiment on the teaching of typewriting", The Vocational Aspect of Secondary and Further Education, 20(45), 3-12.

135. JONES, G. (1965) "Organic research projects in an undergraduate course", Education in Chemistry, 2(5), 238-240.

136. KENSHOLE, G. (1968) "A teaching experiment in a first-year university course", Physics Education, 3(1), 49-50.

137. McCARTHY, W.H. and GONELLA, J.S. (1967) "The simulated patient management problem", British Journal of Medical Education, 1(5), 348-352.

138. MACFARLANE SMITH, I. (1968) "A further experimental study of the effects of television broadcasts on the G. courses in engineering science 1", The Vocational Aspect of Secondary and Further Education, 20(45), 78-85.

139. McKEVITT, O. (1967) "The use of television recordings in university staff training", Australian Journal of Higher Education, 3(1), 83-87.

140. McLEISH, J. (1968) The Lecture Method. Cambridge Monographs on Teaching Methods No. 1, Cambridge Institute of Education.

141. MacMANAWAY, L.A. (1968) "Using lecture scripts", Universities Quarterly, June 1968, 327-336.

142. MADDOX, H. (1968) "A descriptive study of teaching practice", Educational Review, 20(3), 177-190.

143. MALLESON, N. (1967) "Medical students' study : time and place", British Journal of Medical Education, 1(3), 169-177.

144. MALLESON, N., PENFOLD, D. and SAWIRIS, M.Y. (1968) "Medical students' study : the way they work", British Journal of Medical Education, 2, 11-19.

145. MOORE, D. (1967) "Group teaching by programmed learning", Programmed Learning and Educational Technology, 4(1), 37-46.

146. PIPER, D.W. (1967) "Strategies in course planning", Design Education 2, 16-18, Hornsey College of Art.

147. RAITT, J.G. (1968) "Teacher training of graduate chemists", Chemistry in Britain, 4(6), 242-244.

148. RAYNER, S.A. (1966) "The induction conference for new staff in the University of Queensland", Australian Journal of Higher Education, 2(3), 189-199.

149. REPIN, V. and ORLOV, R.S. (1967) "The use of sleep and relaxation in the study of foreign languages", Australian Journal of Psychology, 19(3), 203-207.

150. REPORTS and PROCEEDINGS (1968) "A course for university teachers, September 1967", Journal of Medical and Biological Illustration, 18 April 1968, 161.

151. RICHARDS, J.P.G. and WILSON, A.J.C. (1961) "A-level and pass degree in physics", Universities Quarterly, 15, 389-391.

152. ROMISZOWSKI, A.J. (1967) "A survey of the use of programmed learning in industry during 1966", Programmed Learning and Educational Technology, 4(3), 210-215.

153. ROYAL COMMISSION ON MEDICAL EDUCATION 1965-86. The Todd Report (1968) HMSO : London.

154. SEYMOUR, W.D. (1966) Industrial Skills. Pitman.

155. STONES, E. (1968) "An experiment in the use of programmed learning in a university with an examination of student activities and the place of seminar discussion", Association of Programmed Learning Conference.

156. TAYLOR, J.L. and CARTER, K.R. (1967) "Instructional simulation of urban development : a preliminary report", Town Planning Institute Journal, 53(10), 443-447.

157. TAYLOR, J.L. and MADDISON, R.N. (1967) "A land use gaming simulation", SCUPAS Bulletin No. 4, Proceedings of 2nd Salzburg conference in urban planning and development, 18-22 May 1967.

158. TEATHER, D.C.B. (1968) "Programmed learning in biology", Journal of Biological Education, 2, 119-135.

159. THODAY, D. (1957) "How undergraduates work", Universities Quarterly, 11, 172-181.

160. UNIVERSITY TEACHING METHODS RESEARCH UNIT, Department of Higher Education, University of London Institute of Education (1968) Innovations and Experiments in University Teaching Methods, report of the third conference organised by the Unit, April 1968.

161. WALTON, H.J. and DREWERY, J. (1967) "The objective examination in the evaluation of medical students", British Journal of Medical Education, 1(4), 255-264.

162. WATSON, N. (1964) "A method of assessing the studio work of architecture students", RIBA Journal, 71, 358-360.

163. WILLIAMS, E.R. and WOODING, E.R. (1957) "Planning a lecture course with the aid of network analysis", Physics Education, 2(4), 202-206.

164. WILLIAMS, E.R. and WOODING, E.R. (1968) "The postgraduate education of physicists", Physics Education, 3(3), 152-156.

165. WRIGHT, E. (1968) "A research project for clinical medical students" in Innovations and Experiments in University Teaching Methods (see 160).

166. WRIGHT, P. (1967) "The use of questions in programmed learning", Programmed Learning and Educational Technology, 4(2), 103-107.

Society for Research into Higher Education

PUBLICATIONS

1. **REGISTER OF RESEARCH INTO HIGHER EDUCATION**

(A loose-leaf volume giving details of more than 160 on-going and recently completed research projects. Annual index and regular supplements)

Annual subscription : £2 (including binder)

2. **RESEARCH INTO HIGHER EDUCATION ABSTRACTS**

(A quarterly publication providing abstracts of the more important literature in almost 200 journals)

Annual subscription : £3

3. **RESEARCH INTO HIGHER EDUCATION MONOGRAPHS**

The following monographs are still available:

No. 2 - "Research into Teaching Methods in Higher Education" by Ruth Beard (56pp., 9" x 6", October 1967, revised September 1968)
Price: 12/6

No. 3 - "Student Residence - a new approach at the University of Essex" by Marie Clossick (72pp., 9" x 6", December 1967)
Price: 17/6

No. 4 - "Student Residence - a discussion of the literature" by Stephen Hatch (26pp., 9" x 6", June 1968)
Price: 7/-

4. **OCCASIONAL PUBLICATIONS**

The following occasional publications are still available:

No. 3 - "Research into Library Services in Higher Education" - papers presented at a conference in November 1967 (36pp., 9" x 6", February 1968)
Price: 8/6

No. 4 - "Research into Higher Education 1967" - papers presented at the Society's Third Annual Conference (52pp., 9" x 6", March 1968)
Price: 10/6

The prices quoted are those payable by non-members of the Society and are inclusive of surface postage. Corporate members receive two copies of the Register and Abstracts and one copy of all other publications free of charge; individual members receive the Register and Abstracts and can buy other publications at substantially reduced prices.

Printed by Direct Design, Christchurch, Hants.